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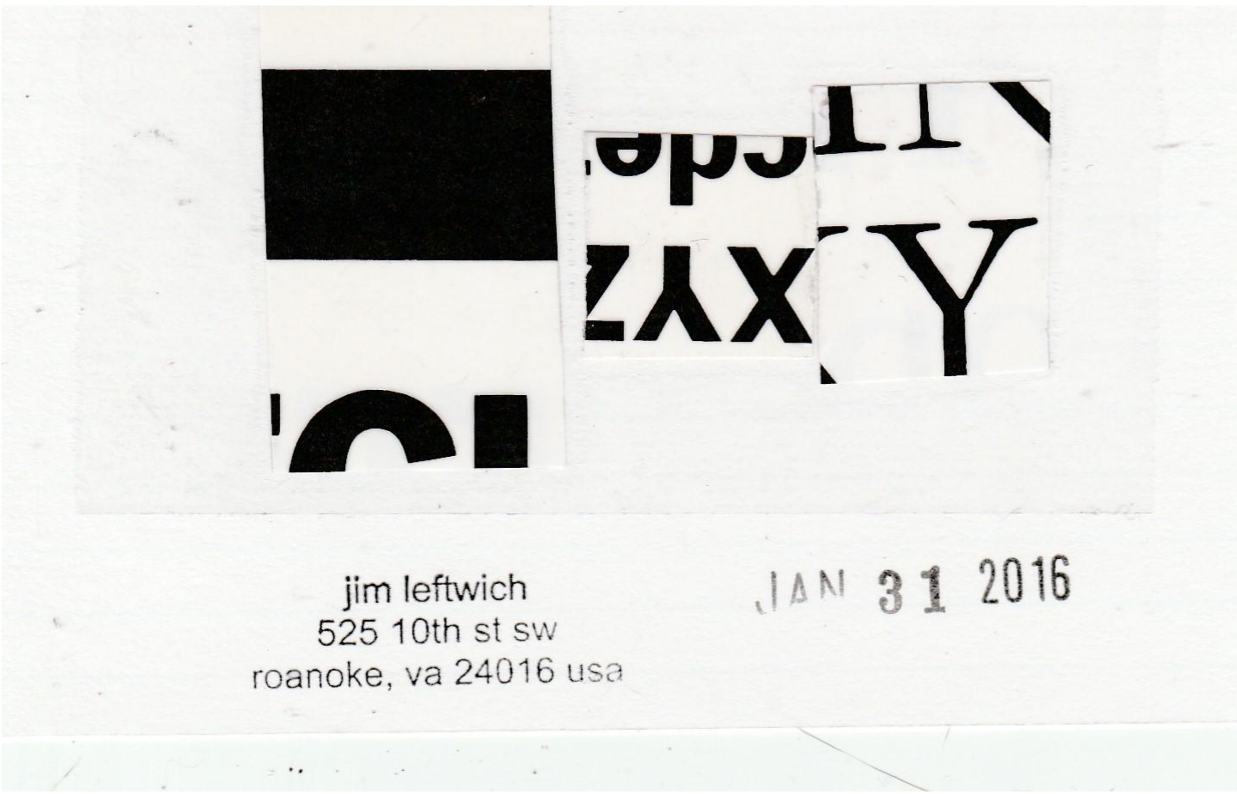

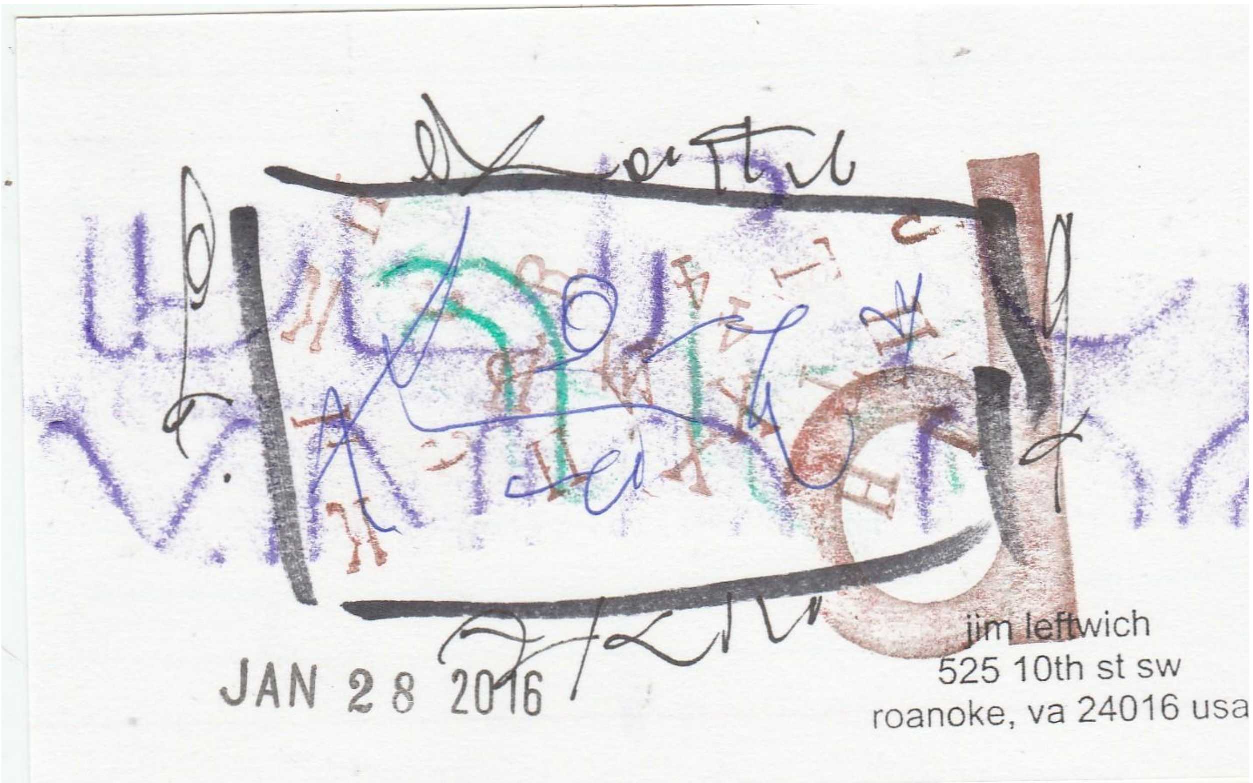
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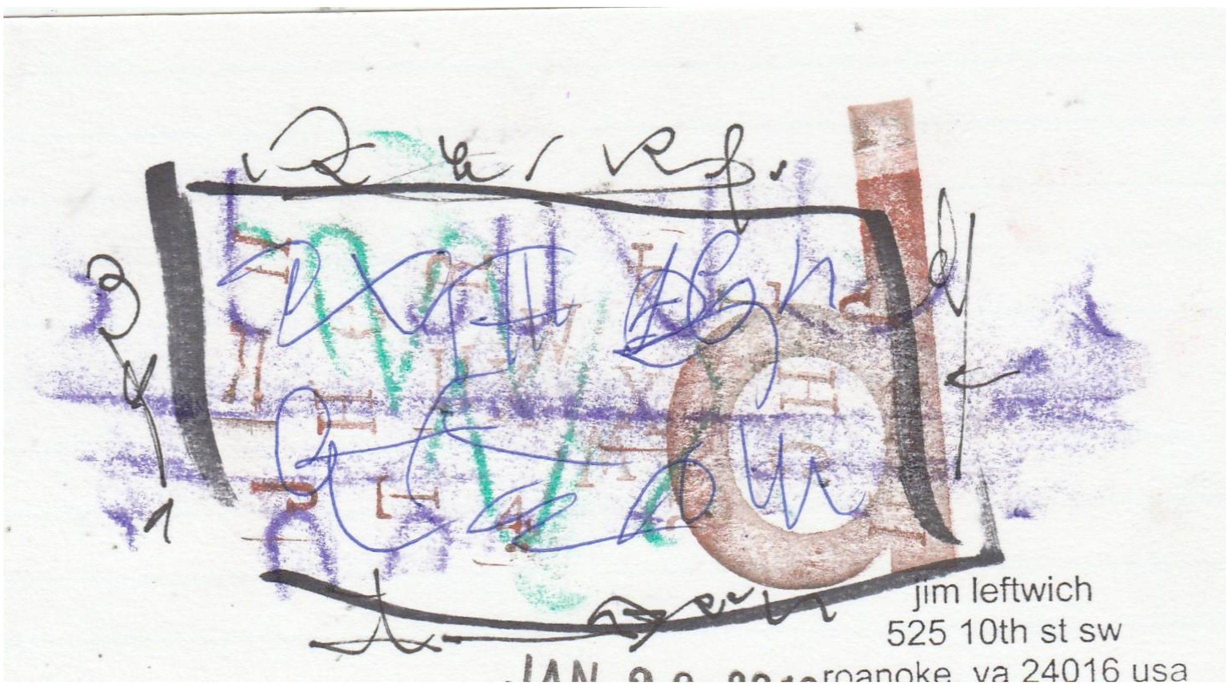
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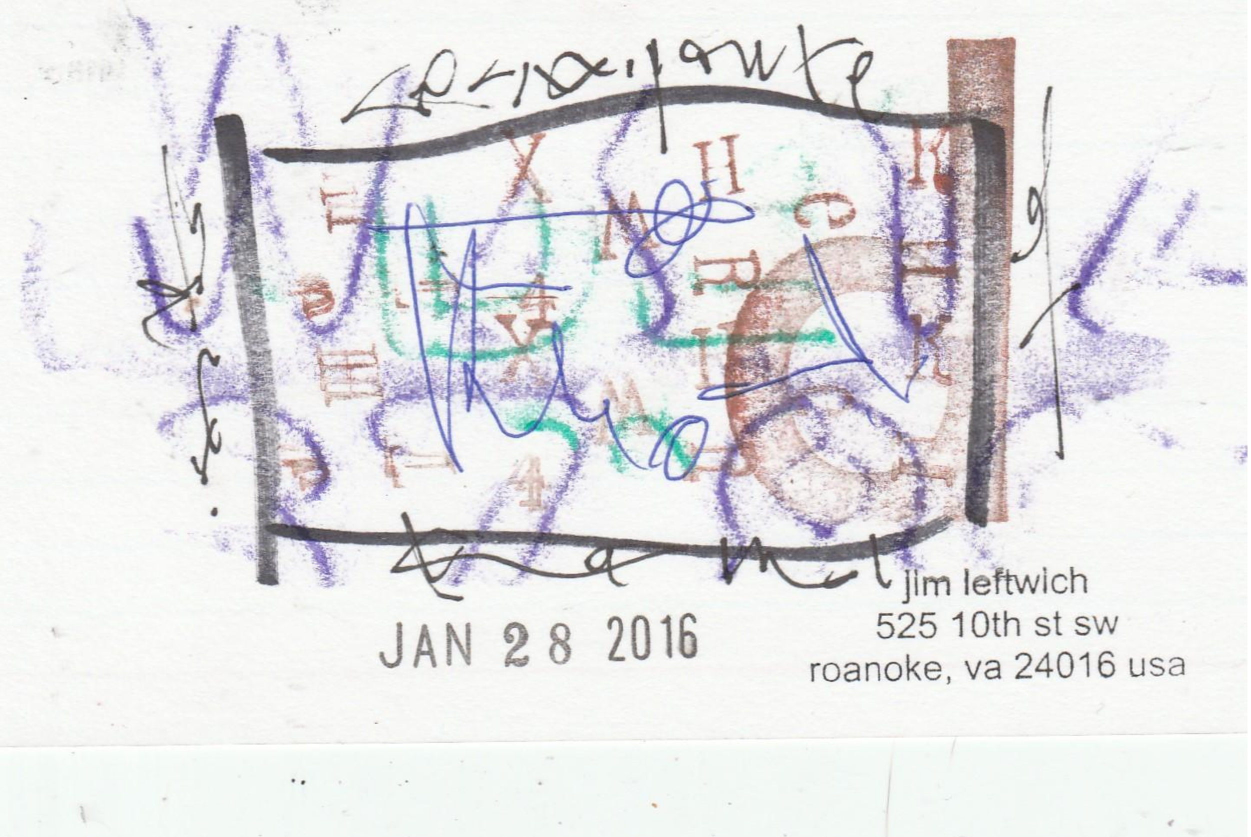
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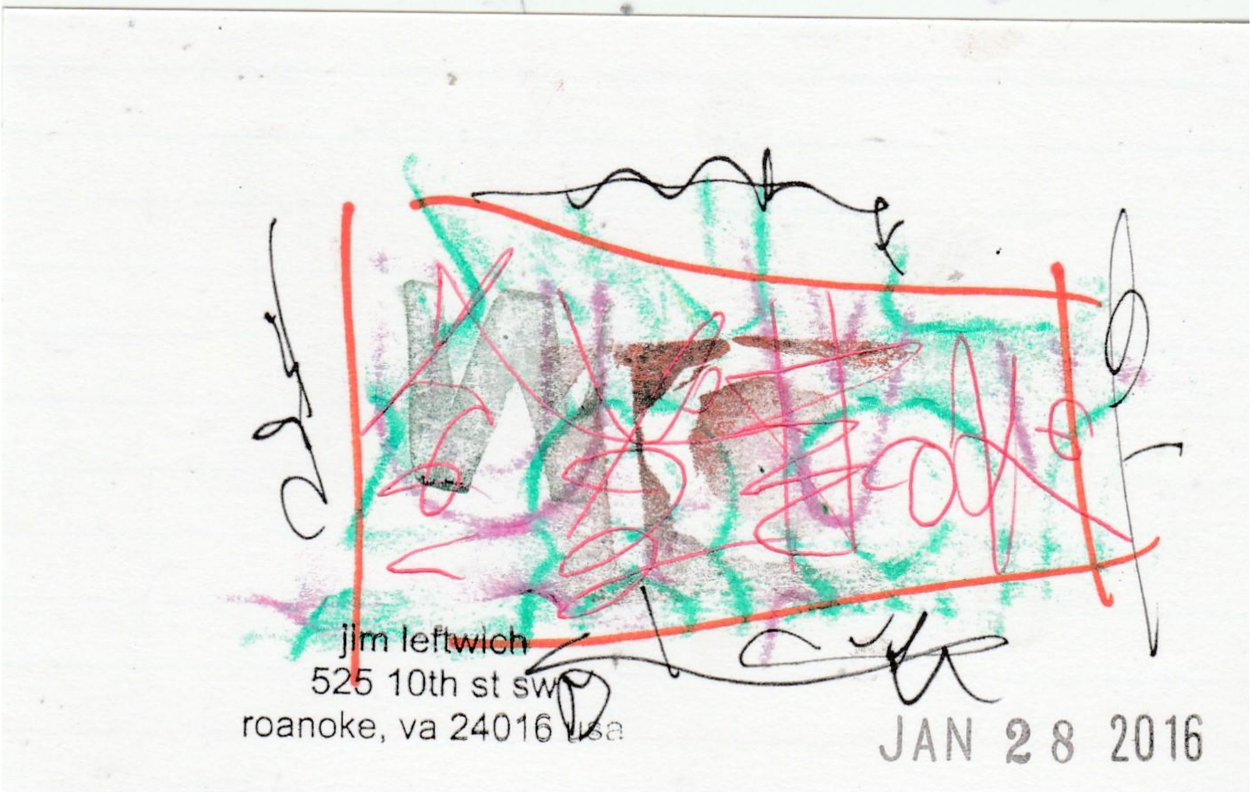
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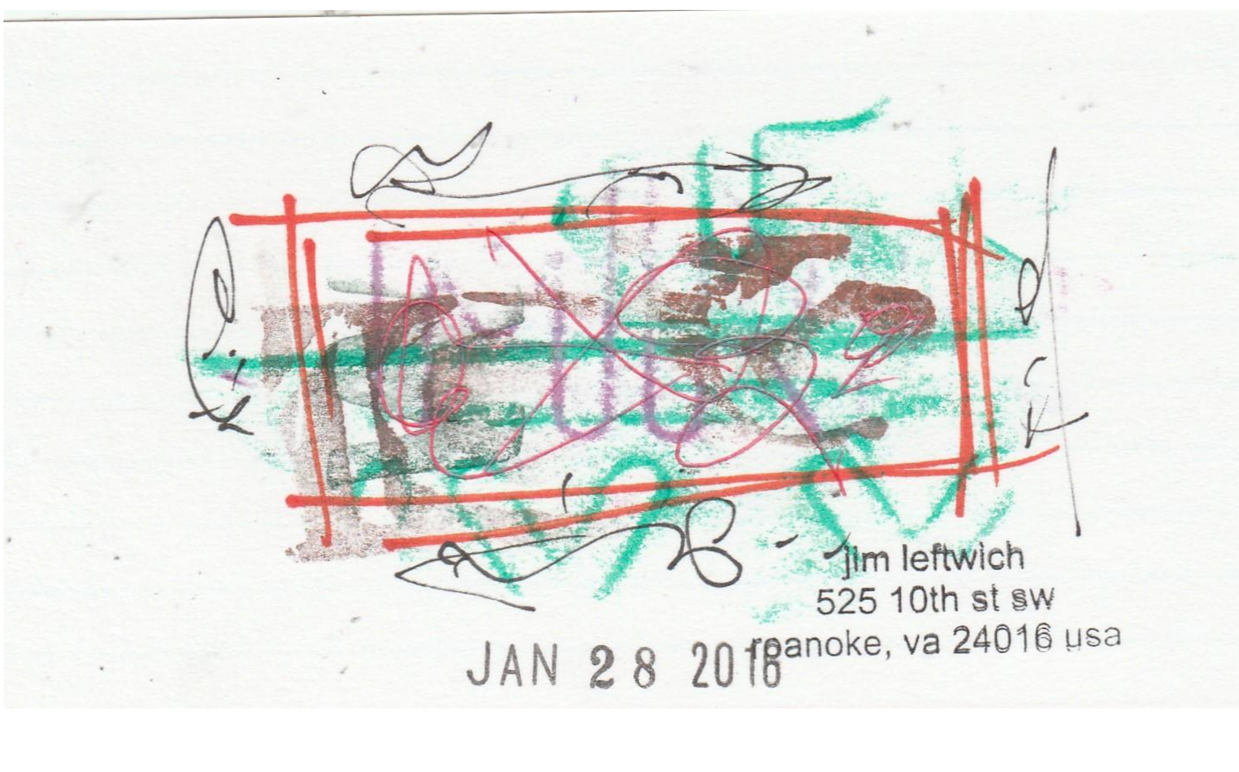
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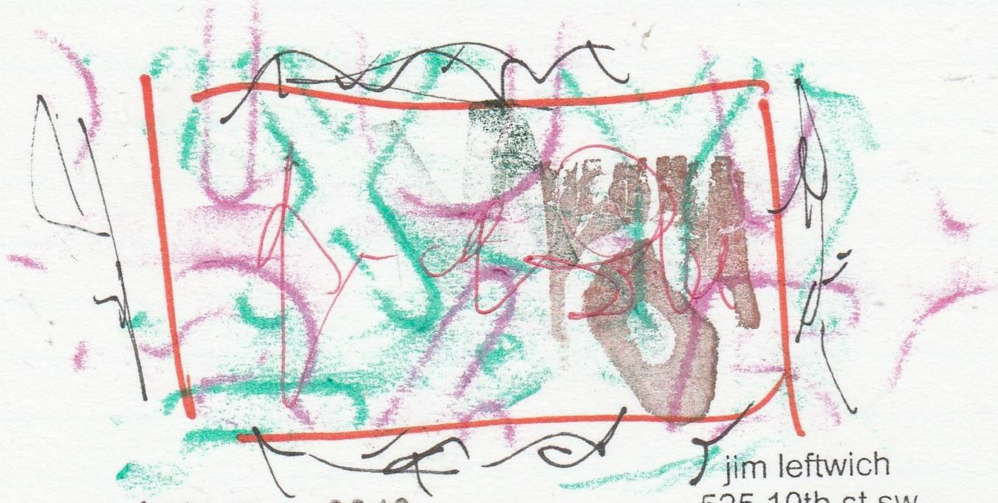

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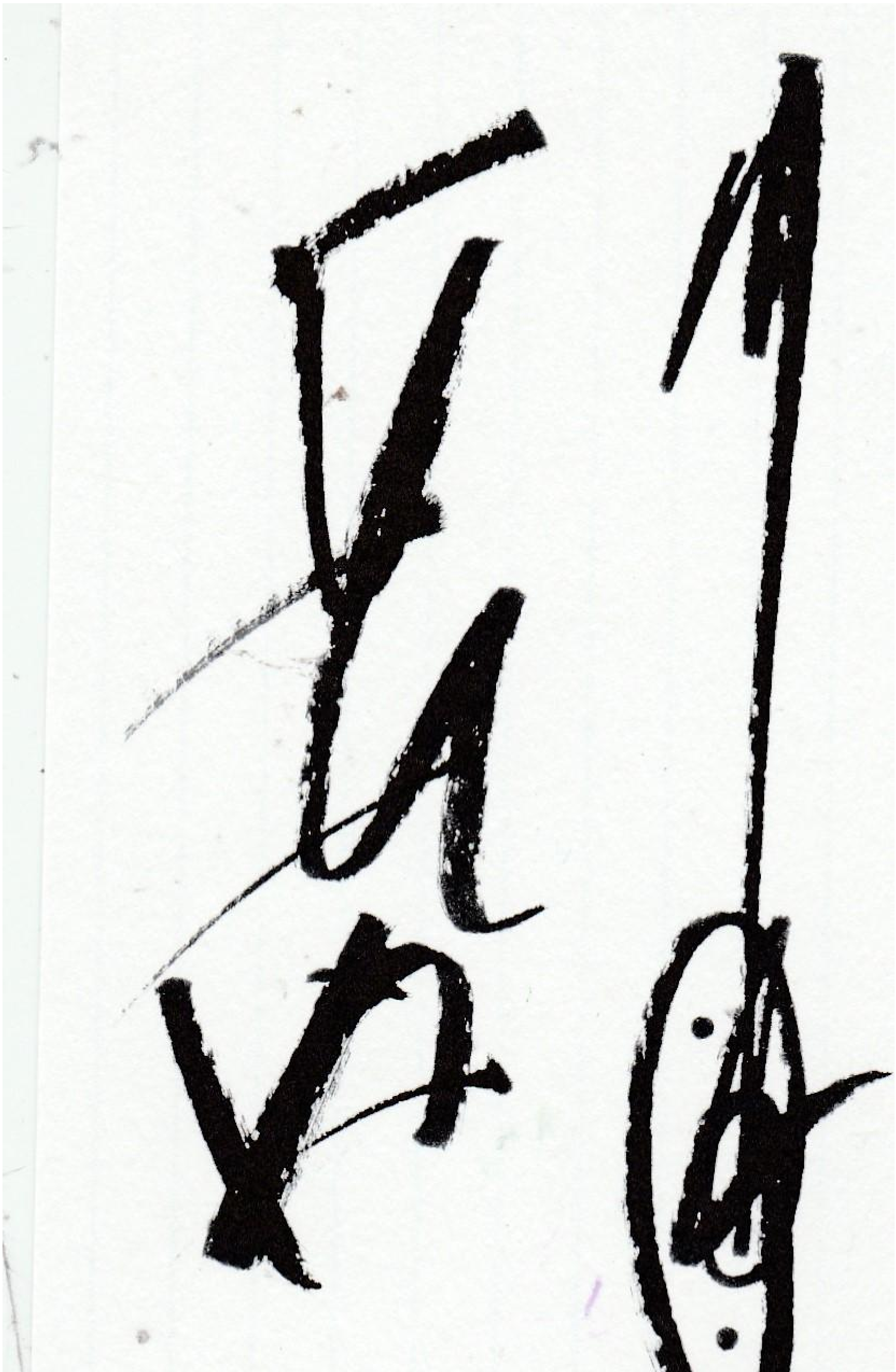

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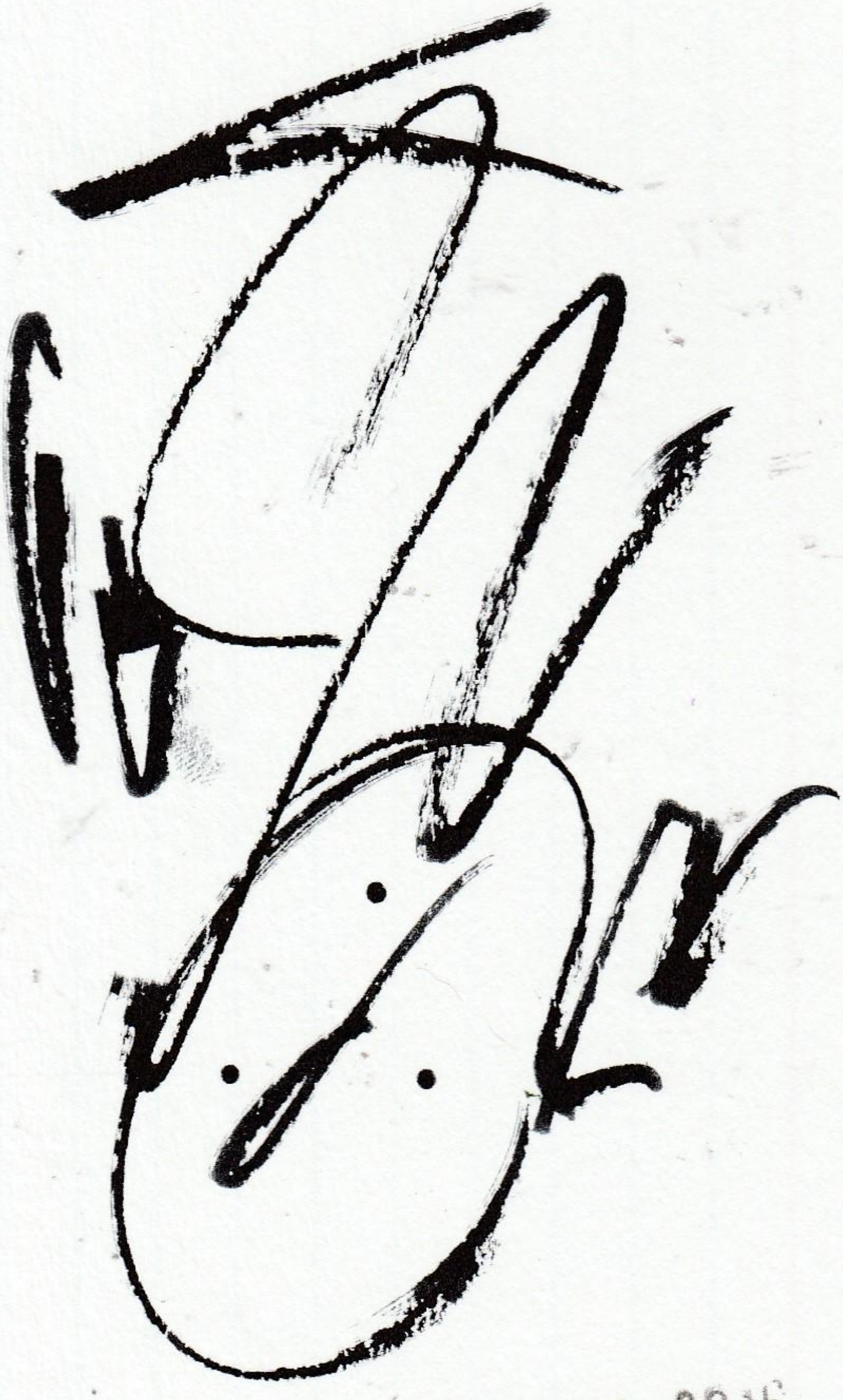

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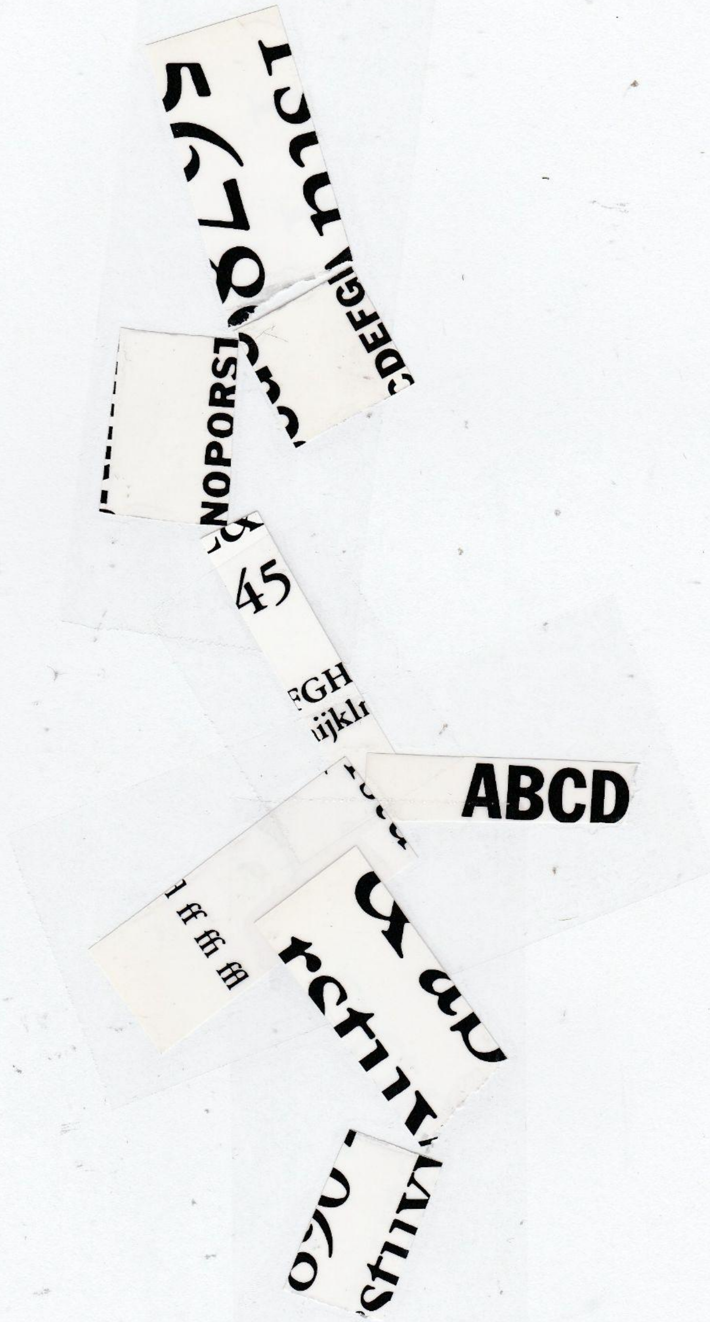

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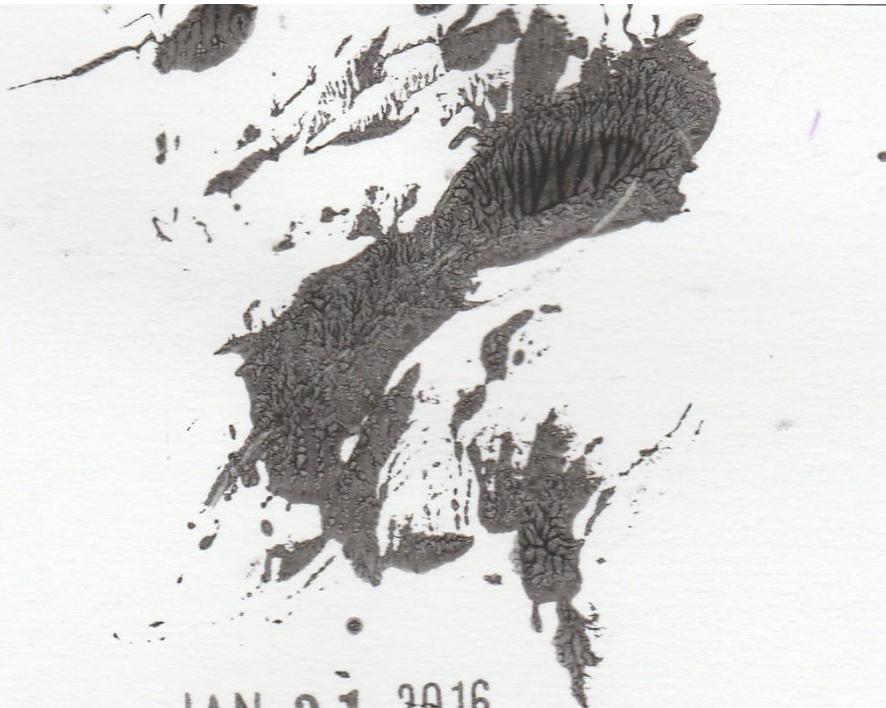

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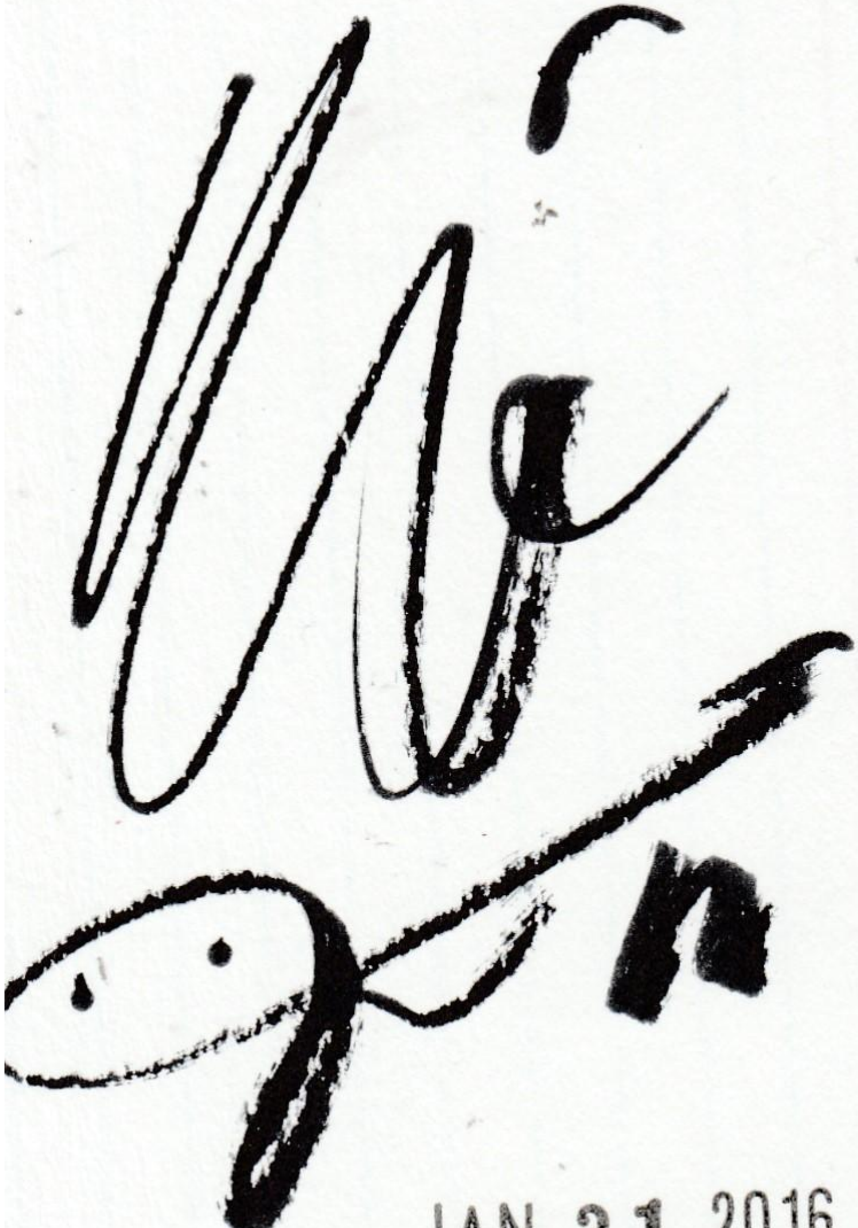

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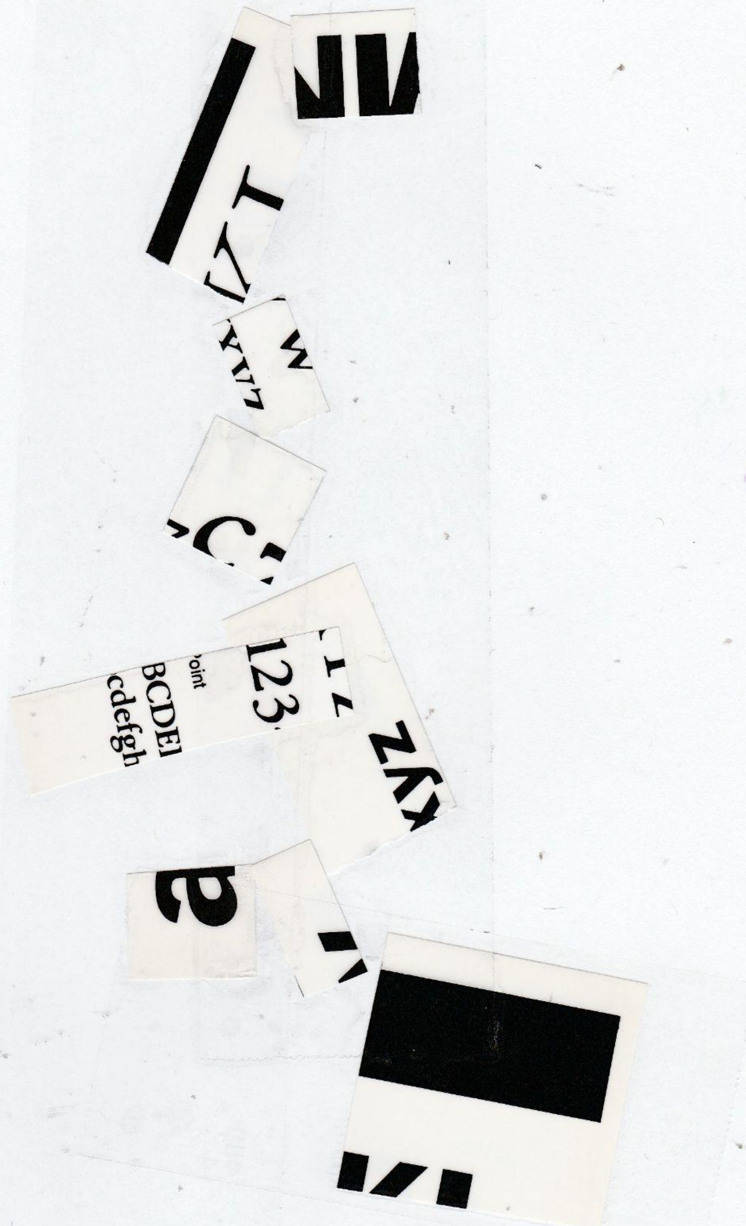

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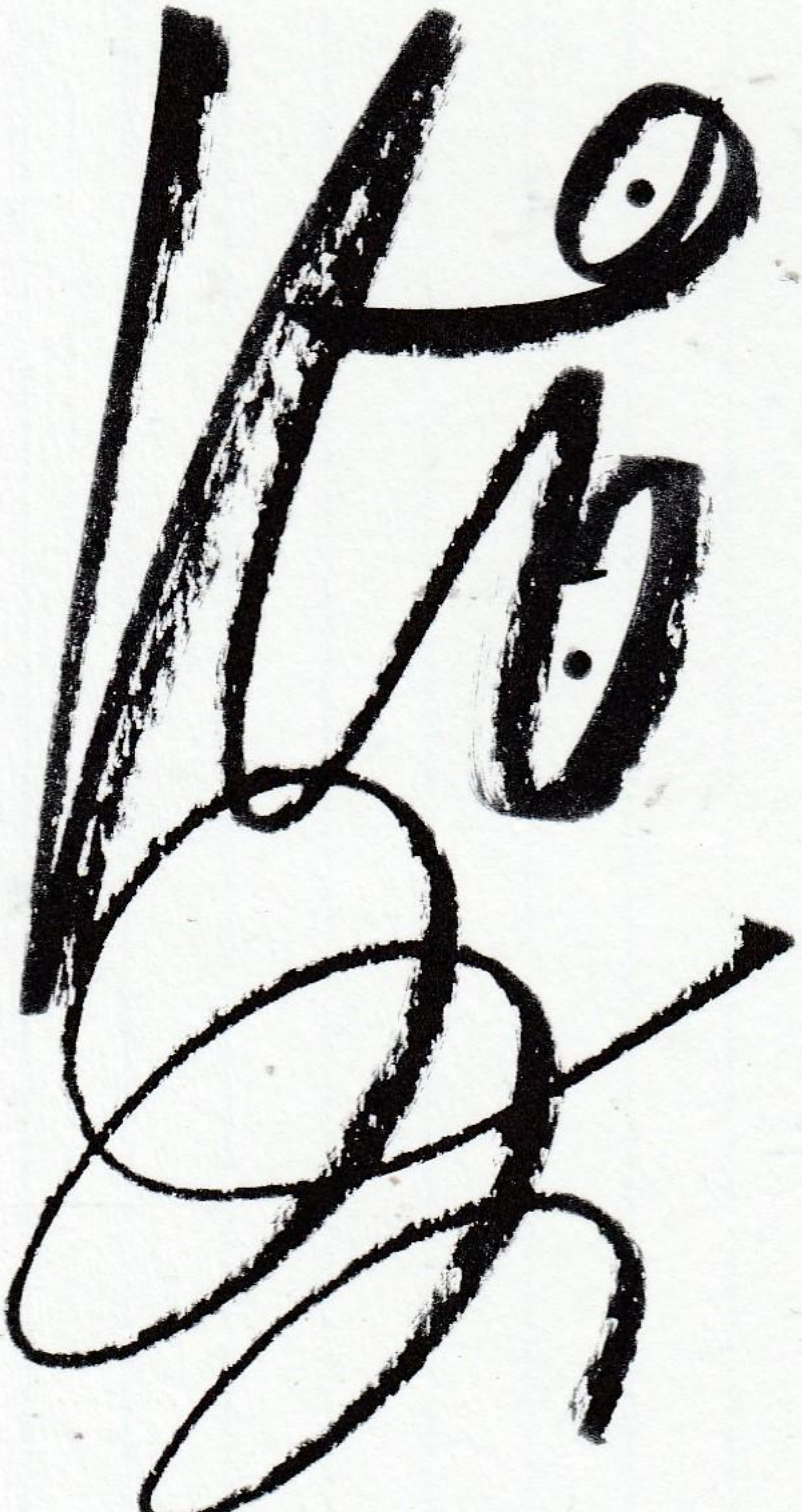

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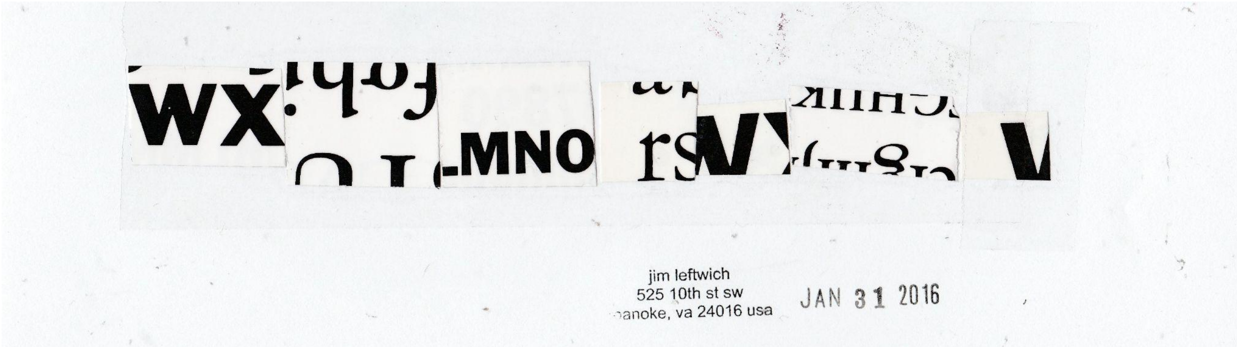
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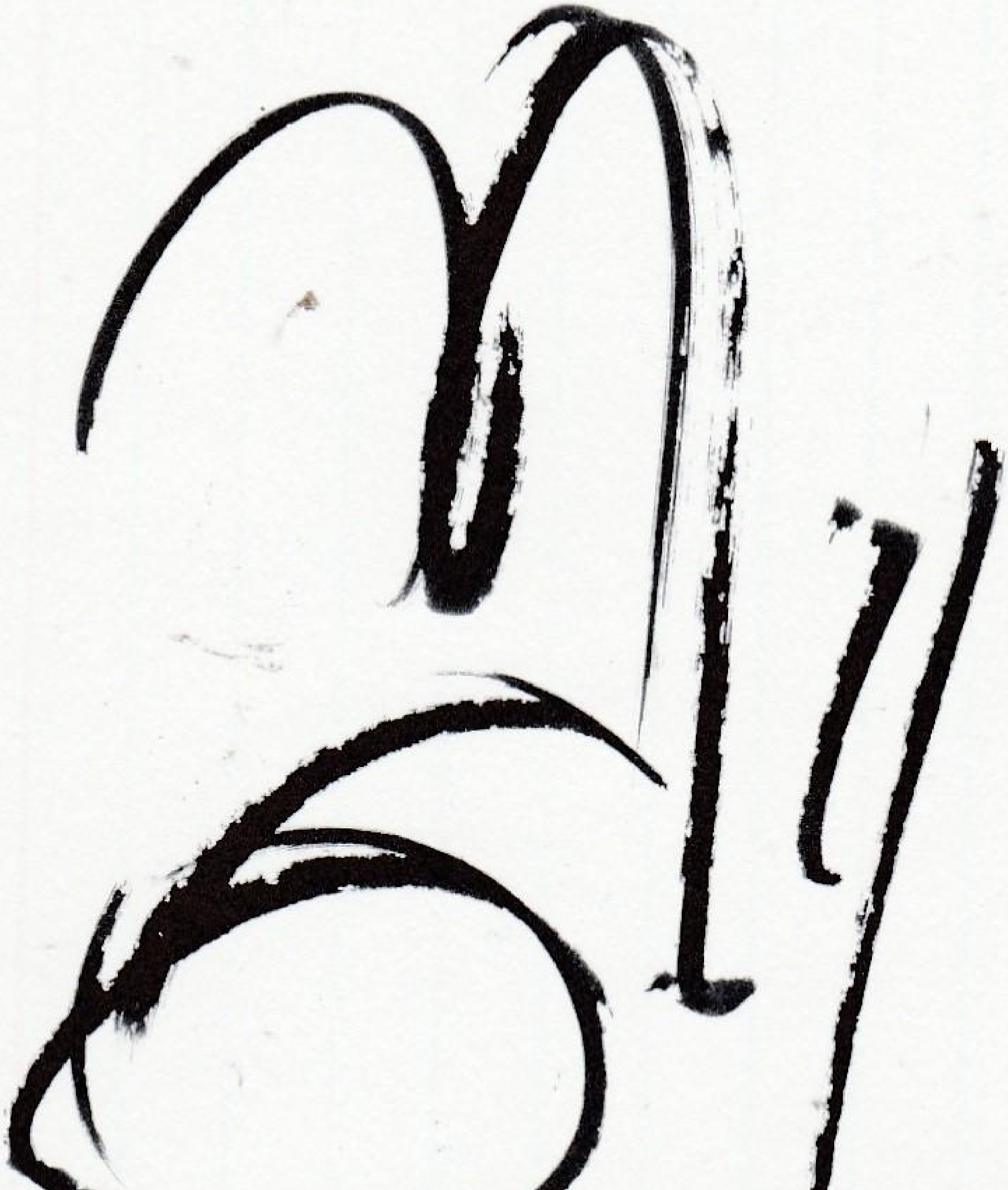

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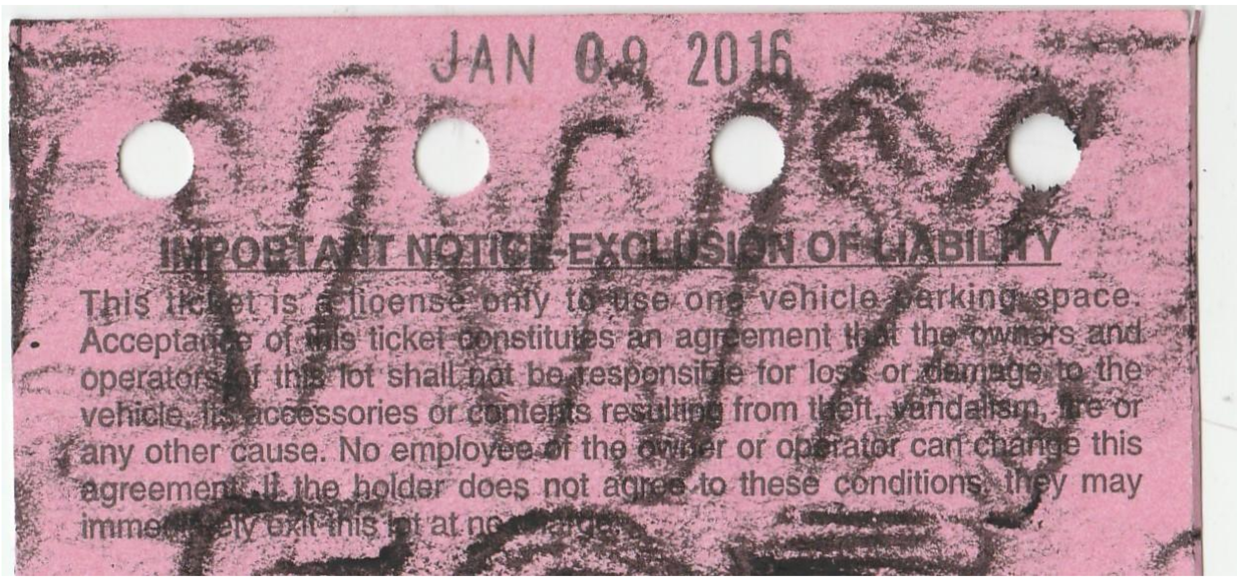

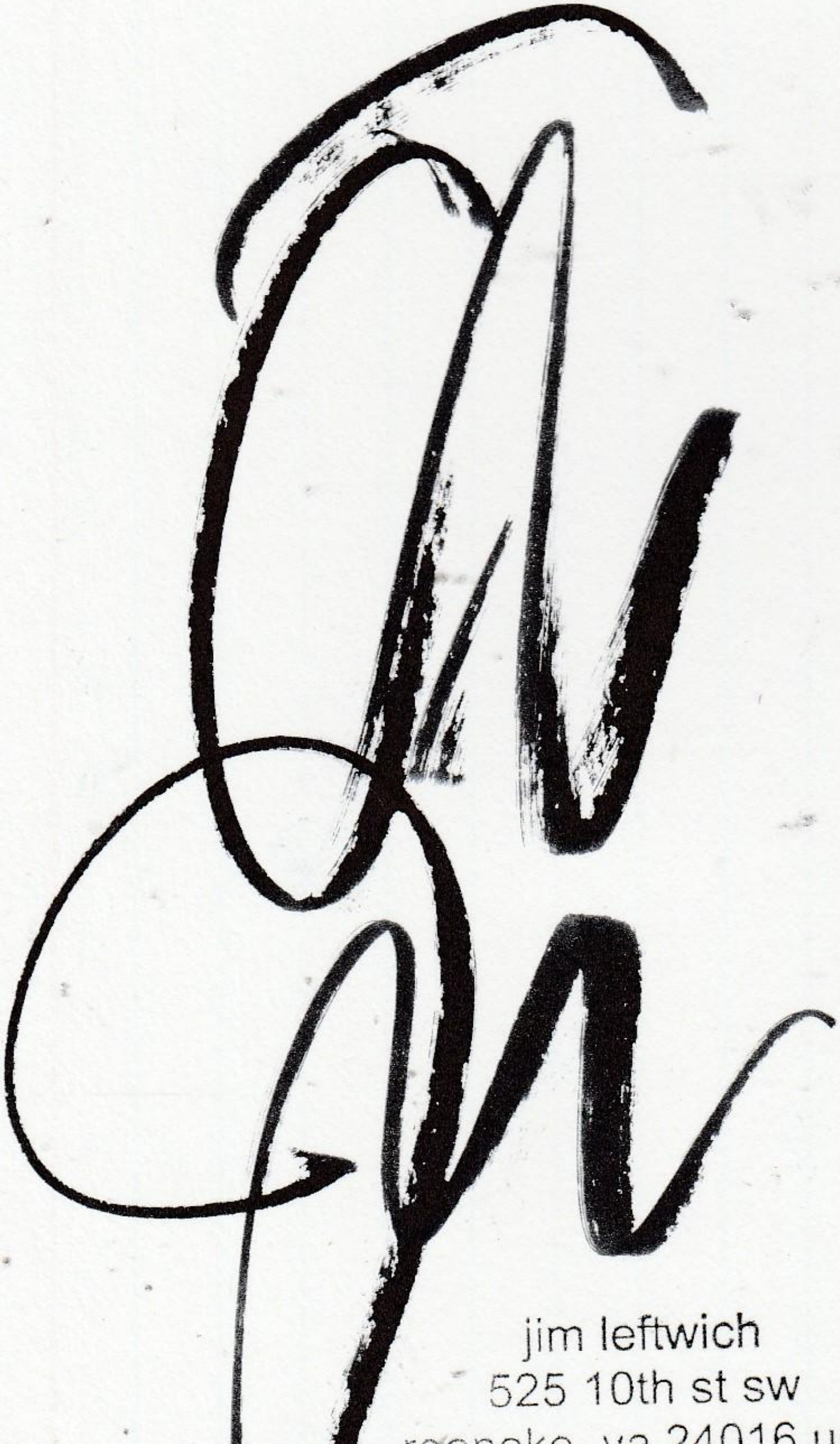

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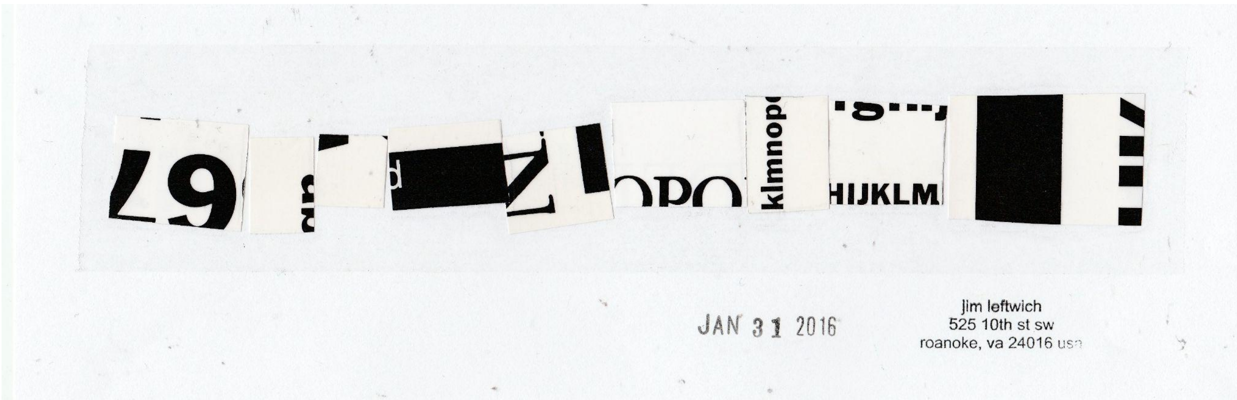
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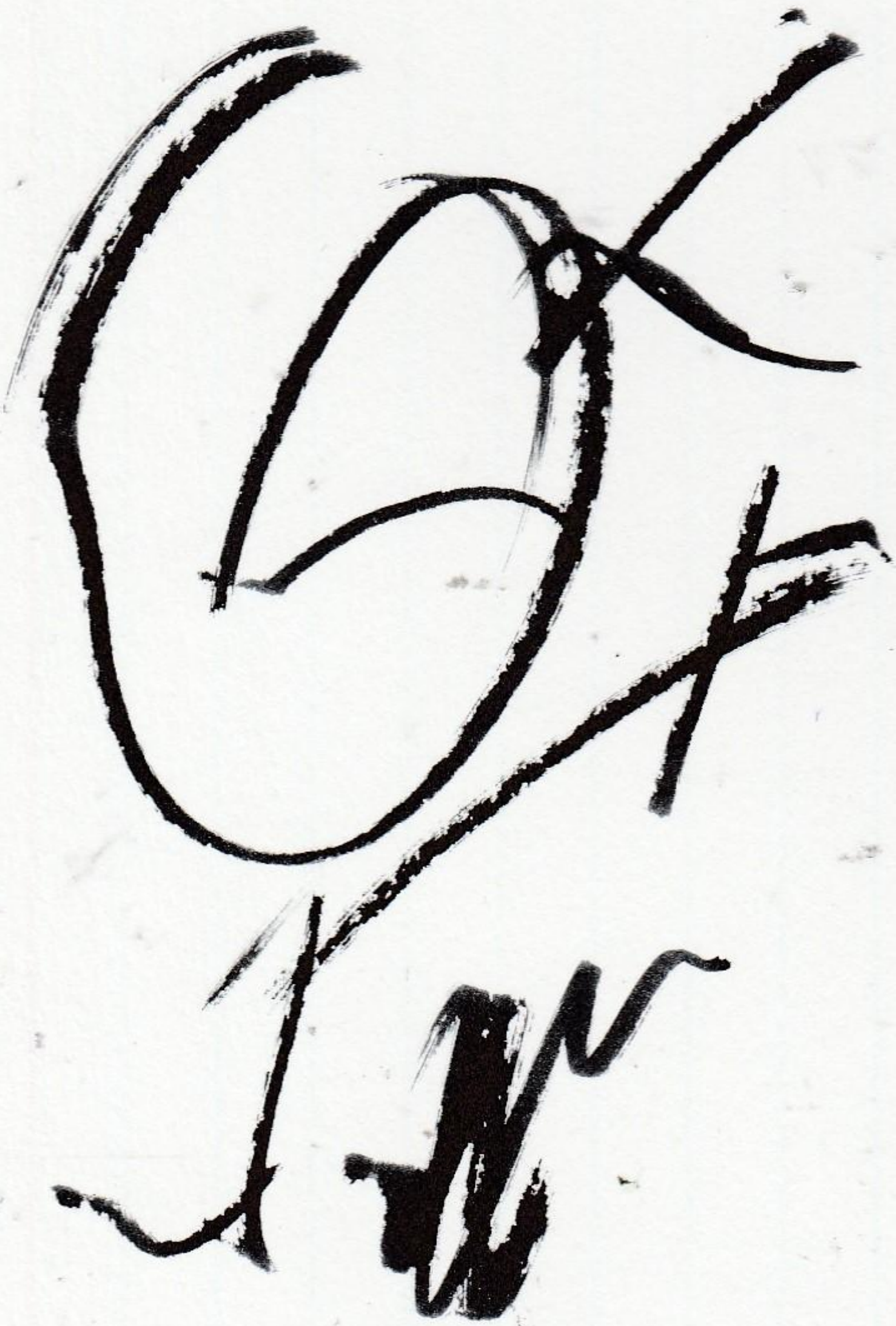

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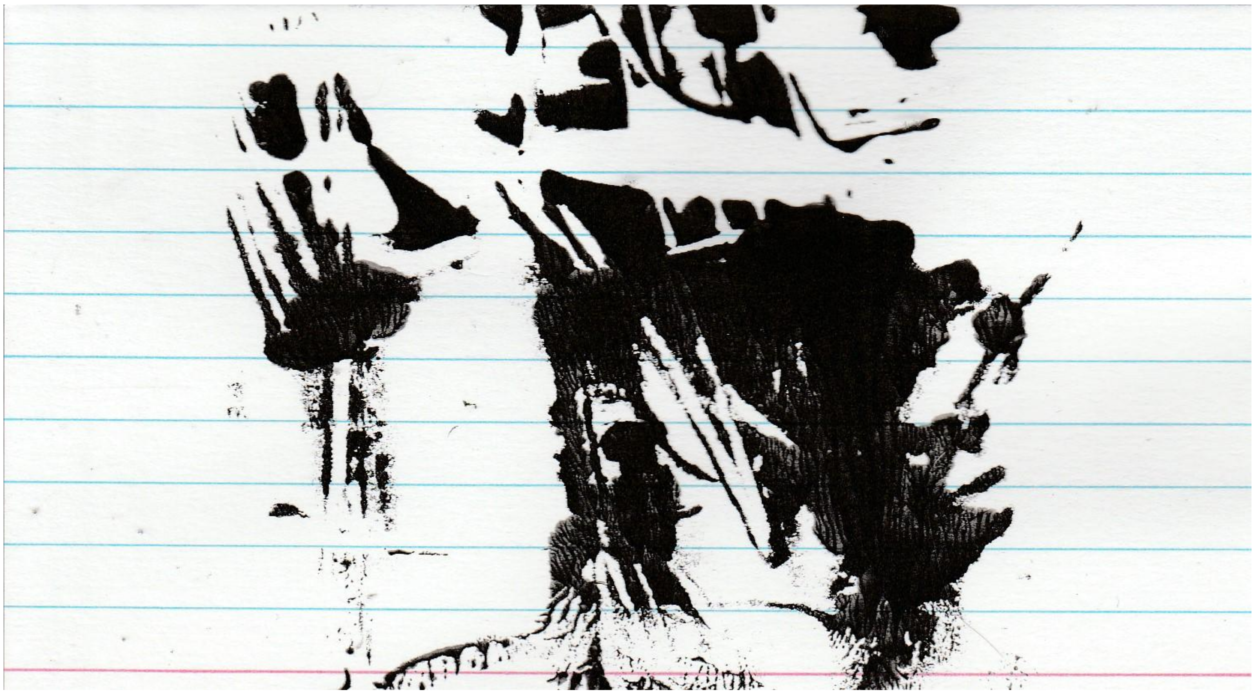

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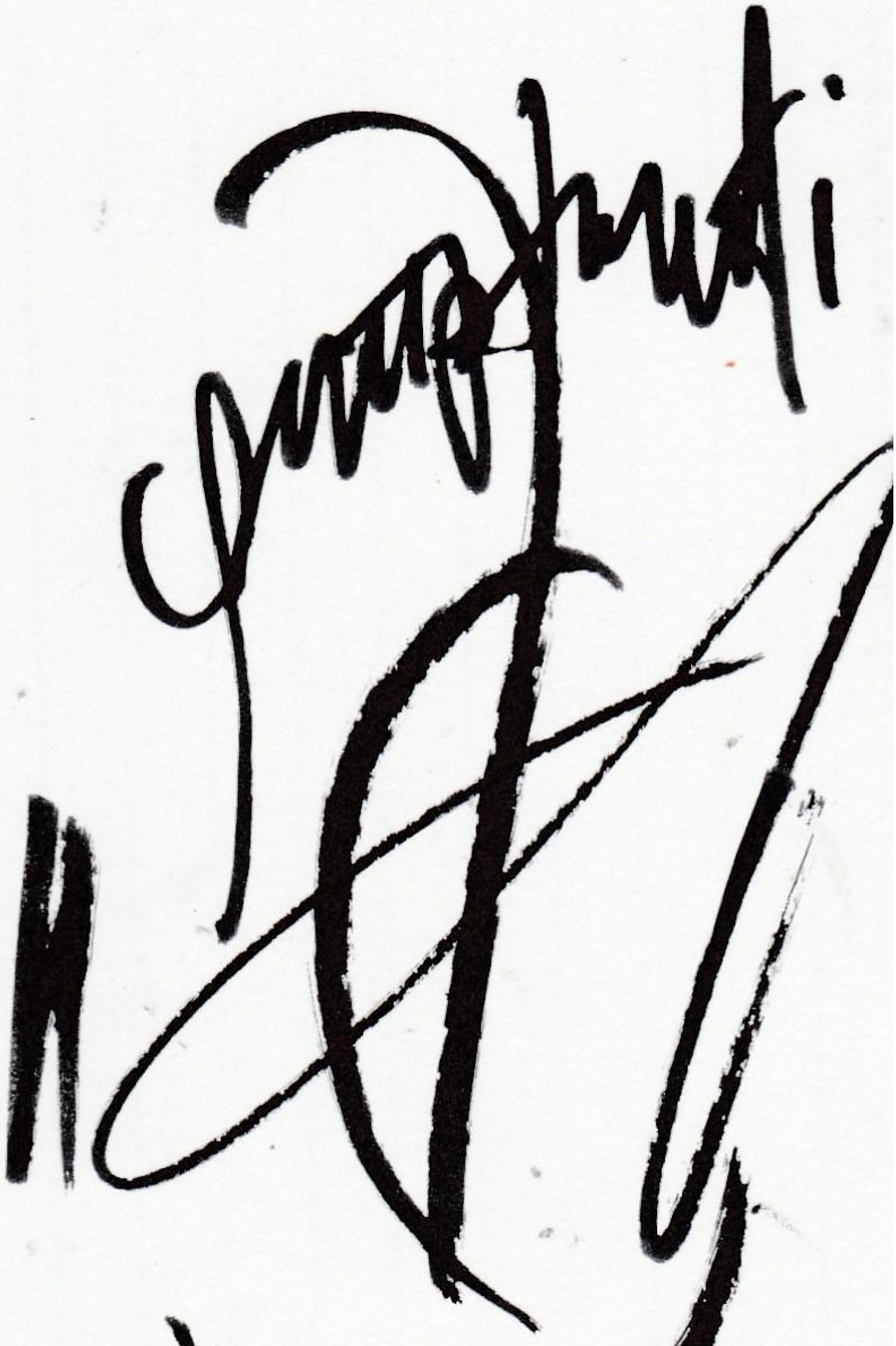

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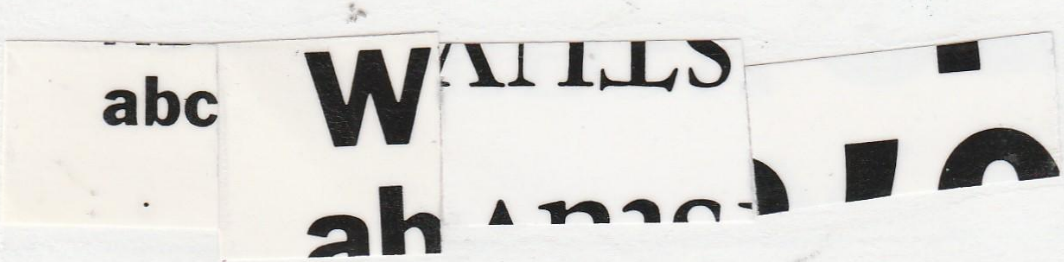

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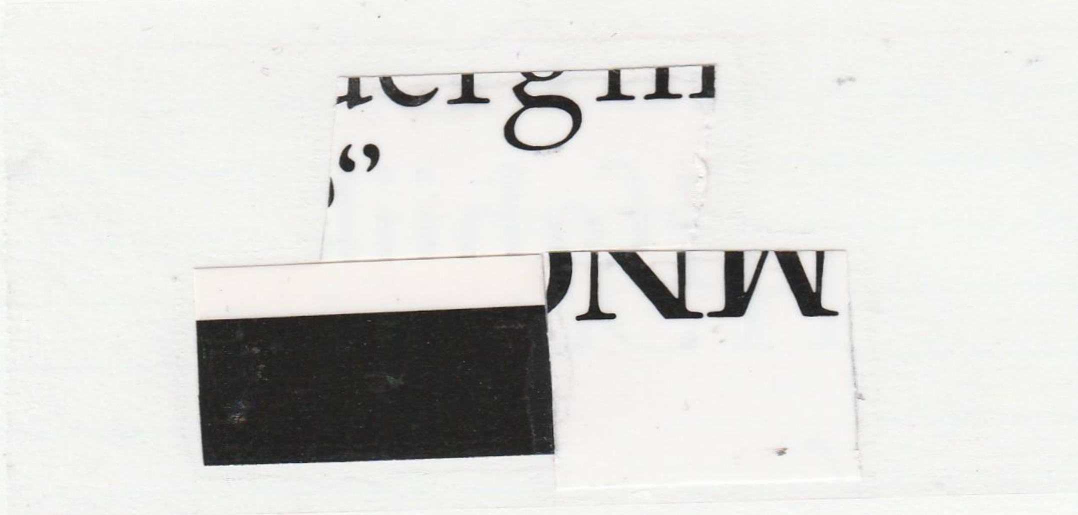

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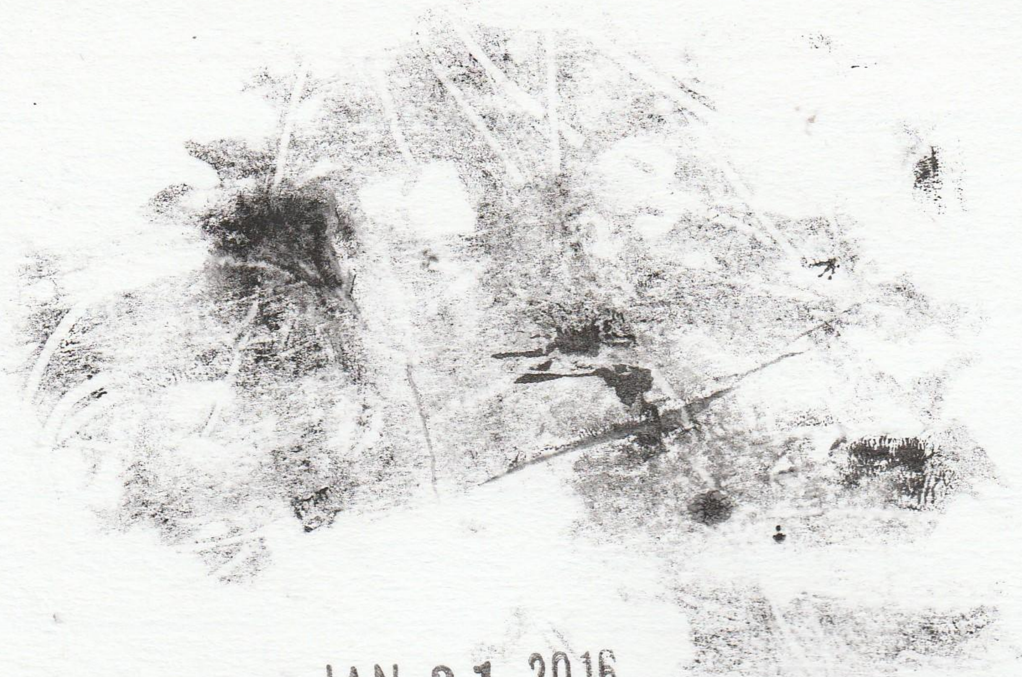

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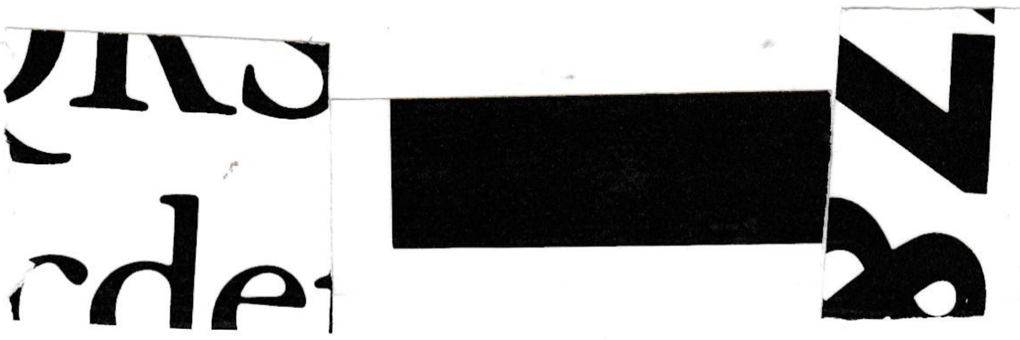

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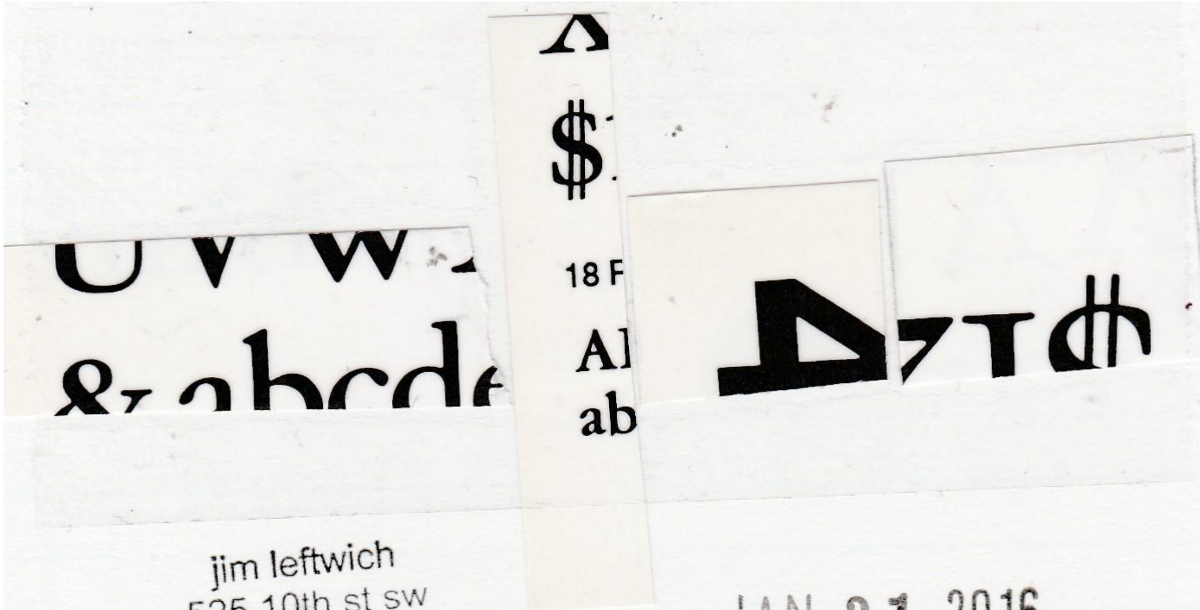

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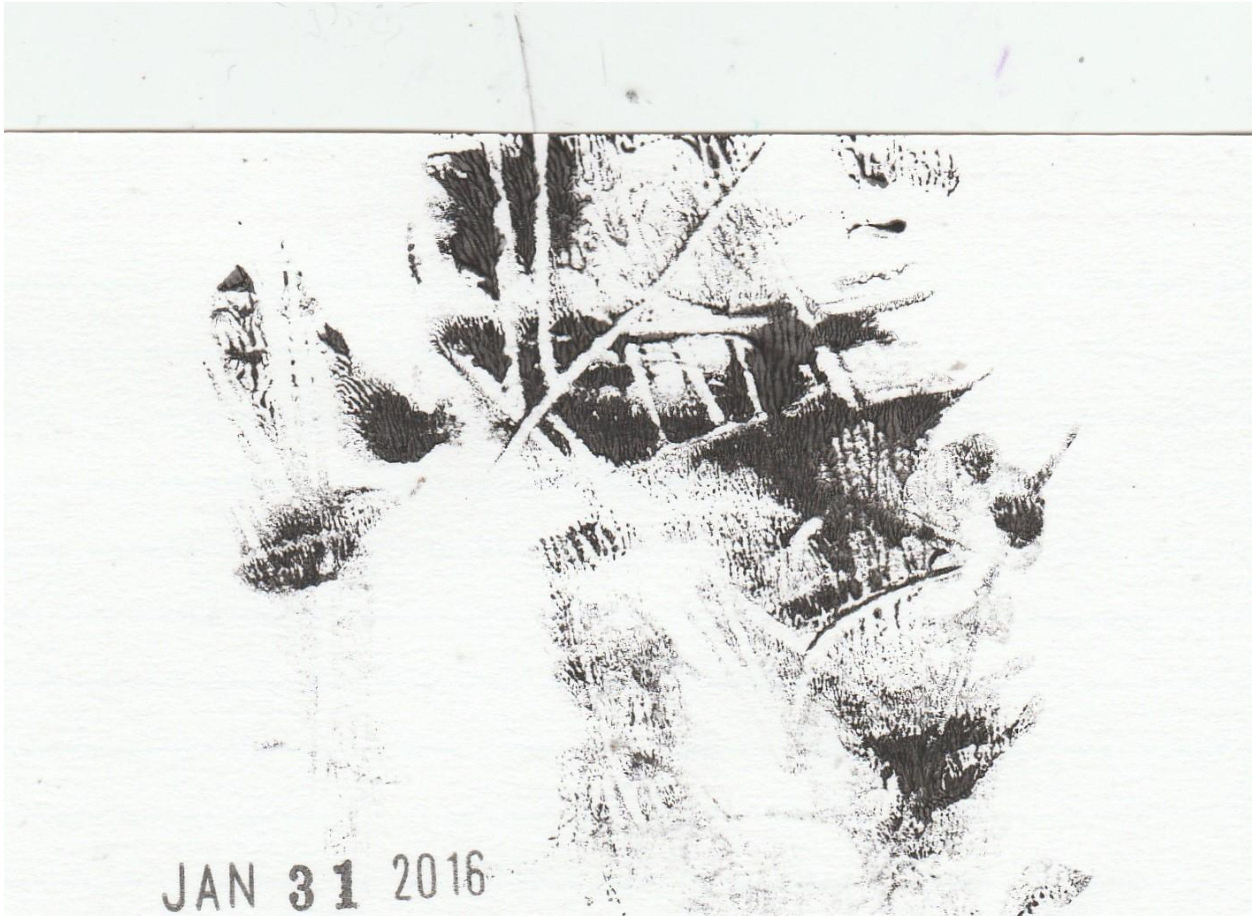

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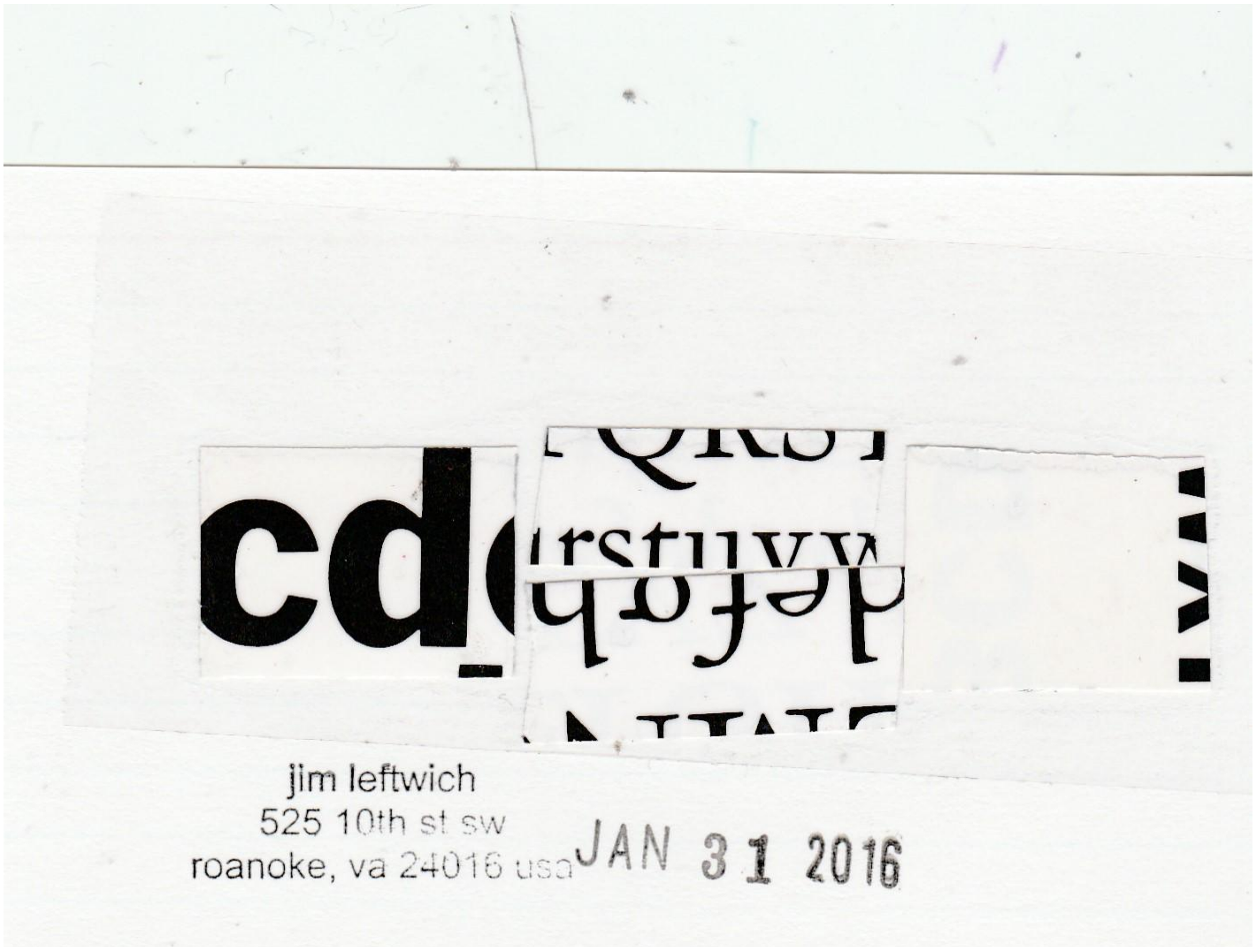
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The space between the fuel and the cladding is filled with helium to facilitate the heat flow. The rod diameter also affects the speed of neutrons within the uranium, and, therefore, the proportion that is absorbed in the uranium-238 and produces plutonium.

Reactor shielding

The shielding of the reactor must keep heat losses and radiation levels external to the reactor down to acceptable levels. In addition to thermal shielding, neutrons and gamma rays must be absorbed. Typically, a "core barrel" also serves to confine the coolant flow within the core region, and is enclosed in a thermal shield, a pressure vessel, a water shield against neutrons, and a blanket of reinforced concrete for gamma-ray absorption; there may be a second concrete blanket, and, finally, the containment wall. In the newer pressurized-water reactors, fuel burnup has been improved to the point that fuel assemblies may be left in the reactor for years before refuelling is required.

Boiling-water reactors (BWRs). These reactors have much in common with the pressurized-water reactors (Figure 58B). The main difference is that the intermediate steam generator is omitted, and steam is supplied directly from boiling water in the reactor core. Less pressurization is needed because the water is allowed to boil, and less pumping is needed because of the large amount of heat absorbed by boiling water. An excellent safety feature is the increase in steam production that results from an increase in power level, thus reducing the water volume and lessening its moderating ability, a condition that in turn reduces the reactivity. In other words, an inadvertent power increase tends to be self-correcting.

High-temperature gas-cooled reactors (HTGR). The conversion of heat to electricity can be accomplished more efficiently if the heat can be generated at higher temperatures, thus decreasing the percentage of the total heat that must be rejected. One of the obvious advantages of a nuclear reactor for power production is that it can be brought to as high a temperature as the materials of which it is made will permit. Limiting factors include melting, change of shape, and corrosion. These effects are sometimes exaggerated under irradiation, and if the materials deteriorate to the point that they interfere with the flow of heat out of the reactor as fast as it is produced, then the temperature of the reactor may increase to unacceptable levels.

The use of gas as a coolant is one method of achieving high temperatures, even though its heat-transfer properties are generally less favourable than liquids (Figure 58C). At higher pressures, the heat-transfer properties of gases improve. Most consideration has been given to helium and carbon dioxide. Air has been tried because of its easy availability, but its heat-transfer properties are so ineffective that excessive amounts of power are needed to circulate the air through the reactor. Furthermore, air has poor chemical properties at high temperatures, and it becomes radioactive under neutron irradiation.

Carbon dioxide is used, particularly in the United Kingdom and in France, in power reactors, although its chemical properties at higher temperatures, particularly under intense radiation, tend to be unsatisfactory.

Helium has the disadvantage of being expensive. It is chemically inert, however, with no corrosion problems; its neutron-absorption cross section is negligible; it is transparent, thus providing visibility during refuelling and maintainance operations; and at high temperatures and pressures its heat-transfer properties improve.

Graphite as a moderator

Graphite, which is used as the moderator in each of these reactors, has good mechanical properties and thermal stability and is a good conductor of heat with low neutron absorption. Although graphite is chemically reactive with air at high temperatures, this property presents no problem with helium as a coolant.

The fuel in the high-temperature gas-cooled reactors consists of highly enriched uranium, together with thorium as a fertile material, each in the forms of carbides embedded in pyrocarbon, a dense form of graphite. Fuel elements of this general type have a potential for achieving very high burnups, in the range, perhaps, equivalent to 500,000 megawatt-days per metric ton (one metric ton = about 2,200 pounds). Burnup is equal to the product of the thermal output of the reactor in megawatts and the days of operation divided by the fuel load in metric tons.

Breeder reactors. Without breeding, uranium as a source of energy is limited. Even in reactors in which the conversion ratio (the ratio of uranium consumed to uranium employed) is improved, there is no possibility of using more than a few percent of uranium. This condition means that for generation of large quantities of power a large amount of uranium must be mined, and also, because so small a fraction of the uranium is utilized, its value is so low that it is not economical to use the more abundant but more expensive uranium obtained from low-grade ores. On the other hand, if a large fraction of the uranium is consumed, it becomes so valuable that the poorest ores may be mined economically, thus extending the available and usable uranium reserves enormously. The same argument applies to the use of thorium reserves through conversion to uranium-233.

In the long run, therefore, breeder reactors are essential if uranium or thorium is to contribute substantially to meeting the world's energy needs.

Liquid-metal fast-breeder reactors. The concept that received greatest emphasis in the 1970s was a liquid-metal fast-breeder reactor (LMFBR) operating on the uranium–plutonium cycle. With liquid-metal cooling, higher temperatures and therefore higher efficiencies were obtainable. Sodium was selected as the coolant because it has favourable heat-transfer properties, a low-absorption cross section for neutrons, and its atoms are heavy enough so as not to slow down the neutrons, thus allowing the reactor to become a fast reactor (Figure 58D).

The fuel generally employed was plutonium diluted by uranium, providing at use, at least for start-up, of the plutonium produced by thermal water reactors. Oxides of uranium and plutonium rather than their metallic forms were used because of their better resistance to radiation damage.

Fast-fuel-test facility

The second experimental breeder reactor (EBR-II), originally intended as an experimental prototype, was used instead as a facility for testing fuels and materials in a fast neutron flux. During the early 1970s, a larger fast-fuel-test facility (FFTF) was built at Hanford, Washington, in order to provide a higher flux capability for fuels and materials testing.

Gas-cooled fast-breeder reactors. This reactor represents an extension of the technology of the high-temperature gas-cooled reactor, but it differs in the absence of graphite as a moderator and in its use of the uranium–plutonium cycle instead of the uranium-233–thorium cycle. The core of the reactor is composed of metallic-clad pins of mixed uranium–plutonium oxide fuel. It has helium cooling with a potential to drive gas turbines directly instead of working through a heat exchanger to supply steam.

The breeding ratio may be high enough so that the doubling time (*i.e.*, the time required to produce an amount of new fuel equivalent to the amount contained in the reactor and its associated fuel cycle at the outset) will turn out to be only about 10 years.

One of the questions about this concept centres on the safety problem in avoiding excessive heating in the event that the helium cooling is accidentally interrupted. Even though the chain reaction in a reactor is stopped, the temperature of the fuel elements can increase because of the heat produced through the absorption of intense gamma rays from fission products. Other questions centre on the performance of the metallic cladding of the fuel elements at high temperatures.

The molten-salt reactor. Experiments have been performed as a step toward a molten-salt breeder reactor that would operate on the thorium–uranium-233 cycle and therefore need not be a fast reactor in order to breed. The fuel is a mixture of lithium-7 fluoride, beryllium fluoride, zirconium tetrafluoride, uranium tetrafluoride, and thorium fluoride.

The circulating molten fuel enters the reactor at 1,175° F (635° C) and leaves at 1,225° F (663° C). The molten-salt mixture is stable at these high temperatures and under the intense radiation, and it has a low vapour pressure, thus avoiding pressurization problems. There are, how-

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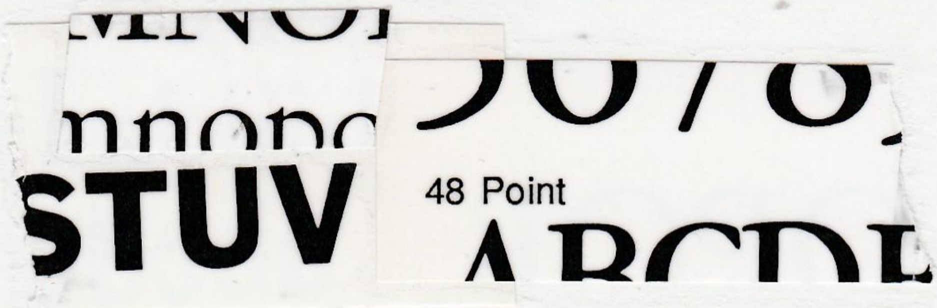

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and large office buildings, a system that is economical in regions of high load density.

A modification known as the primary network system extends a similar plan to supply the distribution circuits feeding the final distribution transformers in residential areas. These circuits are usually overhead, and fuses or relays and circuit breakers are relied upon to isolate defective circuits. Each distribution circuit is fed from two sources, however, so that a high degree of reliability is achieved with relative economy. This plan is not as widely followed as the secondary network system.

Electric power systems

THE ELECTRIC UTILITY

The electric utility is unique in that it sells a product that must be generated at the instant it is to be used. With existing technology, it is impossible to build up an appreciable stockpile of electric power, so that the utility must be ready to generate enough electricity to satisfy the demand at any time. If the utility has excess generating capacity, it can usually cover any anticipated demand; but an overabundance of excess capacity means that too much of the plant is idle too much of the time, thereby increasing costs. At the same time, few products have a greater need for quality and reliability. Quality of service is measured by the degree of attainment of standard voltage and frequency in the supply of electric power. System design and operation determine how close to the standard the voltage and frequency can be maintained. Reliability is measured both by the number of interruptions to service and by the number of customers affected. The ideal, to reduce the number of interruptions to zero, would mean exorbitantly high levels of investment; as a matter of practical economics, electric power systems are designed to keep interruptions within tolerable limits. Even to meet this goal requires making appropriate investments in plants and using the latest technology.

Private electric utilities can operate only by the grant of a special privilege or franchise from the national or local government that permits use of streets, subsurfaces, and other public property. The franchise is usually granted only to a single concern in any given area, creating a monopoly. In the past, duplication of service to one area was sometimes permitted to increase competition. In such cases the streets were cluttered with facilities and equipments were duplicated, leading to an overinvestment. A franchise, therefore, gives the utility certain rights and imposes corresponding duties.

A utility has legal rights that allow it: (1) to invoke under certain circumstances the law of eminent domain to obtain property—that is, invoke condemnation proceedings to acquire it; (2) to charge and obtain a reasonable rate for the service; and (3) to establish and enforce reasonable rules and regulations under which it provides service. The principal duties are that the utility must: (1) serve all who apply for the service; (2) provide power up to maximum capacity and be prepared to meet future increases in demand; (3) provide service that is adequate and safe; (4) not discriminate unfairly among customers (though it may serve different categories of customers at different rates); (5) not obtain more than a reasonable price for its service.

Components of a typical electric utility

The physical property of an electric utility usually comprises the following:

1. One or more power stations, which may be thermal stations using coal, oil, gas, or nuclear fuel, a combination of some or all of these, hydroelectric stations, or a combination of both types. Each power station has a switchyard containing transformers, circuit breakers, and control equipment.

2. A transmission line, usually constructed on private rights-of-way.

3. Transmission substations with transformers to reduce the voltage to several subtransmission circuits, with attendant circuit breakers and control equipment.

4. Distribution substations in which the subtransmission voltage is again reduced to supply transformers mounted on poles for general distribution in suburban and rural areas or to supply transformers in vaults for underground distribution. For industrial customers, electricity is delivered at transmission voltage, at subtransmission voltage, or at distribution voltage, depending on the size and location of the factory and the most economical supply in the circumstances.

SYSTEM CHARACTERISTICS

In addition to the components of the electric-power system named above there is the customer's load, which varies greatly. In residential load electric lighting is used in the evening, electric cookers are used about mealtime, electric cleaners and irons at any time, and electric refrigerators are switched on and off throughout the day and night by automatic control devices. Radio and television use depends upon the programs. Electric air conditioners and electric room heaters comprise a large residential load, their use depending on the weather.

Effects of weather on residential loads

The commercial load, as in offices and department stores, is high during business hours but low at other times. Lighting and air conditioning account for the greater part of the total load. The industrial load is highest during working hours, which depend on the nature of the factory and the number of shifts. Motor and heating loads usually consume the most electricity.

The load on the electric-power system is the varying sum of all the residential, commercial, and industrial loads.

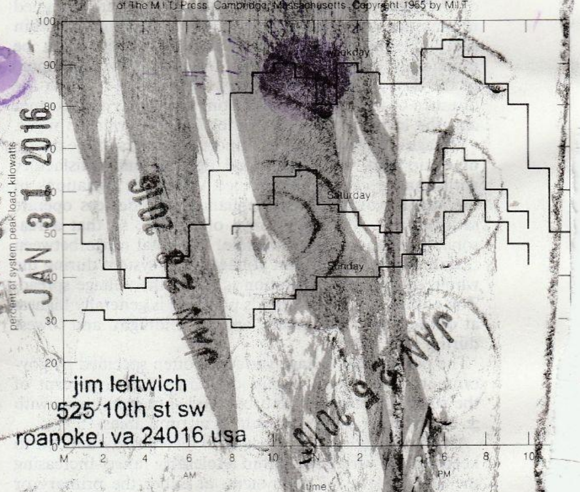

Figure 30: Typical daily load curves for a power station. The load is recorded in hourly steps.

An example of a system load curve is given in Figure 30. The demand shown is the hourly integrated average value; instantaneous peak load is 100 percent. Around midnight the load is low, and the facilities are not used very effectively. To encourage power consumption during off-peak hours, reduced rates for room heating and water heating are frequently offered. Air conditioning accounts for an increasing percentage of the residential and commercial load and heightens seasonal variations. In some countries, such as the United States and Japan, the summer load exceeds the winter load—as evidenced by brownouts (voltage reductions), if not by blackouts (load cuts), in U.S. urban areas.

A smoothed load curve and the load duration curve are shown in Figure 31. The load duration curve can be derived from the load curve and used for planning purposes. A typical yearly load duration curve for a specific system is shown at the left in Figure 32. This curve may be divided into three parts: base, middle, and peak load. The base load, the lowest load of the system, is present continuously, day and night, throughout the year. Peak load is defined rather arbitrarily as the heavy load portion of heaviest load, accounting for 5 to 15 percent of the hours in the year.

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Fission products as by-products

transported to a chemical-processing plant in which the fission products and the plutonium are removed, leaving unused uranium to be converted back to uranyl hexafluoride for re-enrichment and re-use. The fission products in some cases have value as radiation sources and may be regarded as by-products that can be used as nuclear fuel. If not, they must be stored as radioactive wastes. The plutonium is a by-product. A simplified diagram of this fuel cycle is shown in Figure 59.

Sources of uranium and thorium. The highest-grade uranium ores available to the Western countries, containing from 1 to 4 percent uranium, are found in the Shaba (formerly Katanga) region of the Republic of Zaire and in Canada. Medium-grade ores in a range of 0.1 to 0.5 percent uranium are found in many parts of the world. One of the most significant lower grade ores is found in the South African gold ore residues. In the United States, extensive phosphate fields, oil shales, and uraniferous lignites contain large amounts of uranium with a concentration of 0.01 percent or less. Uranium is present in seawater in large amounts, but at extremely low concentrations.

Large deposits of thorium ores are found in India, Canada, and Brazil in monazite-bearing sands. Lesser amounts occur in Australia, Madagascar, South Africa, and the United States.

During purification, the uranium oxide is usually converted first to a nitrate and then to uranium dioxide. If the fuel product is to be enriched, it may be converted first to uranium tetrafluoride, commonly referred to as green salt, and then converted further to uranium hexafluoride. The latter is a gas at temperatures above 133° F (56.5° C) at atmospheric pressure and may therefore be fed through the gaseous diffusion process.

Monazite ore may contain as much as 10 percent of thorium dioxide. The extraction and purification of thorium as a nitrate is carried out in a manner analogous to that for uranium. It may then be converted first to thorium tetrafluoride and then reduced to the metal or converted to the oxide.

Enrichment of uranium. Enrichment requires the separation of the isotopes of uranium-238 and uranium-235. They are chemically identical and differ only in that uranium-238 has a slightly greater mass.

The principle of the gaseous diffusion separation process is to allow the uranium in gaseous form (uranium hexaflouride) to diffuse through a porous barrier. On the average, the lighter molecules have a slightly greater speed in order that their kinetic energies may be the same as the heavier molecules. These lighter molecules will be in contact with the walls of the container more frequently than the heavier molecules and therefore are more likely to encounter a pore and pass through the barrier. Each barrier has hundreds of millions of pores per square inch with the average pore diameter being about 0.000002 inch (0.00005 millimetre).

The difference in penetration is very small because the masses of the two molecules are so nearly the same. Nevertheless, it is possible to obtain desired enrichments by arranging the barriers in a cascade so that the effect is multiplied over and over again. Thousands of barrier stages are used with high pressure on one side and low pressure on the other. The uranium hexafluoride enters at about the middle of the cascade. As the gas moves through the cascade from high pressure to low pressure in each stage, it becomes more enriched. The gas moving in the other direction contains increasing proportions of uranium-238. A pump is required between each stage; thus the pumping capacity of the plant and the electric-power requirements for the pumps are substantial. Because it has been the major source of enriched uranium since that first developed by the Manhattan Project, gaseous diffusion technology is well developed.

Another process involves the use of a high-speed centrifuge. Centrifugal forces cause the heavier atoms to gravitate toward the periphery of a spinning centrifuge, thus producing some enrichment in the gas remaining near the centre. One of the major difficulties is the construction of centrifuges that will themselves withstand the strong centrifugal forces.

Fabrication and preparation of the fuel. For homogeneous reactors, the fuel is in the form of a fluid and there is no need for fabrication or cladding. It must merely be in the proper chemical form.

Fuel types

For heterogeneous reactors, fuel is used in many different chemical forms and shapes and with different types of cladding. The fuel should have a high thermal conductivity, be resistant to radiation damage, be chemically stable (particularly with respect to the coolant in the event of leakage through the cladding), and it should be easy to fabricate. Uranium has been used in the form of a pure metal, as a constituent of an alloy, in the form of its oxide, its carbide, and in other forms. Each has its advantages and disadvantages with respect to particular reactor types. Uranium metal corrodes in water and changes its shape under irradiation. Uranium dioxide has a better radiation resistance, thus allowing higher burnup, but its thermal conductivity is low. Uranium carbide has high thermal conductivity, favourable mechanical properties, and excellent dimensional stability under irradiation.

Fuel cladding must have a low neutron-absorption cross section if it is used in thermal reactors. It must be mechanically strong (to withstand possible outside pressures or internal pressures caused by the accumulation of gaseous fission products). It must be radiation-resistant and able to withstand attacks by both the fuel and the coolant at the temperatures existing in the reactor. Materials that have been used include aluminum, magnesium, stainless steel, zirconium, graphite, and various carbides. In most cases, some bonding material is used to improve the thermal contact between the fuel and the cladding.

Fuel burnup. The revenue-producing portion of the fuel cycle occurs in the period when the fuel is within the reactor. In general, the longer it can stay inside the reactor, the more the other costs in the cycle are offset. The limits on burnup are determined by changes in the reactivity of the reactor and by the physical condition of the fuel. The accumulation of fission products that absorb neutrons and the reduction in the amount of fissionable material (uranium-235, uranium-233, or plutonium-239), thus diminishing the supply of neutrons, could eventually bring the chain reaction to a stop. The production of plutonium (or uranium-233) would be an offsetting factor helping to maintain reactivity. In most cases, however, radiation damage to the fuel elements would make them unusable before they reach the point at which reactivity is too low. The fuel or cladding may change shape or become corroded or brittle or deteriorate in other ways, so that the heat flow to the coolant is interrupted or fission products may escape into the coolant.

Fuel reprocessing. [illegible] the fuel elements are first removed from the reactor, they must be allowed to cool long enough for the radioactivity of the fission products to decay to acceptable levels, a process [illegible] them in shielding water [illegible] a month or more. The chemical separation process, even after this cooling-off period, has to be carried out under conditions of intense radioactivity.

After being transported in suitably constructed radiation-resistant containers, the fuel is taken to a chemical-separation plant in which the jacket may first be removed mechanically, or the fuel may be dissolved with its jacketing still in place, depending upon the fuel and the circumstances. Great care is taken to make certain that at no time is there a large enough quantity of fissionable material accumulated to allow a chain reaction to occur. Separation of the uranium and plutonium may be carried out by one of three general methods: (1) aqueous processes with the principal separation being accomplished by solvent extraction techniques; (2) volatility methods depending on the distillation of uranium hexafluoride; and (3) pyrometallurgical (or melt-refining) processes, such as those that provide for removal of impurities as oxides. Other procedures based upon liquid-metal or fused-salt extraction, metal distillation, zone melting, and electrorefining have been studied.

Fuel rejacketing

Radioactive-waste disposal. The disposal of the highly radioactive wastes that remain as liquid residues after removal of the uranium and plutonium and any fission products having practical value represents one of the more

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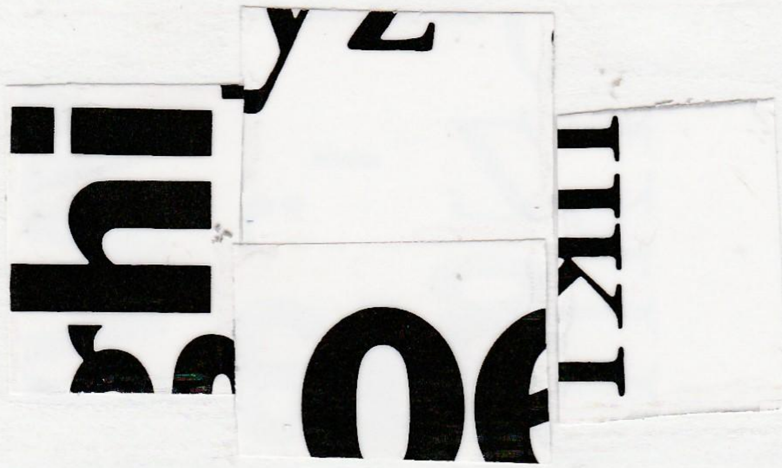

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does not have the benefit of high-speed protection. This problem has been solved by superposing a carrier current signalling system on the distance relay. The carrier signal is used to block the tripping of distance relays in the unfaulted sections. Microwave relaying has also been used.

Electronic relays. All the relays mentioned above are electromagnetic relays. Their operating principle is based on electromagnetic induction. Electronic relays, which came into use in the late 1960s, have the advantages compared with the electromagnetic relay of faster operation (there are no moving parts and contacts), smaller volume, and less power needed for operation.

Digital relays. Relays using digital computers were developed during the 1970s. Instantaneous values of voltage and current in each phase of the electric power system at an occurrence of a fault can be determined, so that digital relays are able to produce the performance characteristics of electromagnetic relays, with quicker operation.

Early dc cables

Underground cables. Underground cables were used for street lighting when Thomas A. Edison began the operation of dc distribution systems in New York City in the 1880s. The structure of the cable was simple: a copper conductor was wrapped with jute and placed in an iron tube, called the Edison tube. In 1884, overhead lines were prohibited in New York City, promoting further development of underground cables. Later, ac transmission was introduced, voltages became higher and higher, and new methods for insulating the cables were introduced.

The cable most commonly used because of low dielectric losses and cost is the paper-insulated, oil-impregnated type. Single-conductor cables are built up by winding layers of paper tape on a stranded conductor and impregnating them with oil. A tight-fitting extruded lead sheath is placed over all. Three-conductor cables may consist of three round conductors, each insulated with paper, with jute filler to round out the cable. Around this is more paper insulation, and a lead sheath over the whole. In general, single-conductor, paper-insulated cable is used up to 69 kilovolts, and three-conductor cable (shielded) up to 46 kilovolts. When the voltage exceeds 69 kilovolts, special designs become necessary.

Besides paper, cable insulation may consist of rubber, varnished cambric, or various synthetic compounds. Increasing the thickness of the paper insulation is no guarantee of improved performance. One of the earliest ways of producing better cables, and one that is still popular, is the use of the Pirelli oil-filled, paper-insulated cable, in which the conductor strands are wound around an open helical spring to form a hollow conductor. Oil under pressure is kept on the cable by means of reservoirs so that no voids can form in the insulation. This type of cable has been in service in Paris since 1936 at 220 kilovolts.

Another widely used cable for high-voltage service is the Bennett pipe-type cable, consisting of three single conductor, paper-insulated cables laid in a steel pipe six to nine inches (15 to 23 centimetres) in diameter. The pipe is kept filled with oil at a pressure of 200 pounds per square inch (14 kilograms per square centimetre). Nitrogen gas is sometimes used instead of oil.

A third type is the compression cable, which resembles the Bennet except that the three cables retain their sheaths (lead or polyethylene), and pressure is exerted on the sheaths. This external pressure on the noncircular sheath acts on the paper insulation to prevent the formation of voids. An advantage of this type of cable is that threading it into the pipe does not require such meticulous care as with other types.

Because the cost of underground cables is much higher than that of overhead transmission lines, it is not generally economical to place cables underground except in very high-load density areas. Elsewhere, however, utilities are often required to place transmission circuits underground for aesthetic reasons. The ratio of construction cost between underground cable lines and overhead lines becomes steadily higher with the increase of the transmission voltages: four to six times at 69 kilovolts and eight to 15 times at 220 kilovolts and upward.

Obtaining rights-of-way for overhead lines in heavily populated areas has become increasingly difficult, making it urgent that the utilities develop techniques for economical underground transmission. Such techniques have included forced cooling of underground cables, either indirectly from the outside or by directly cooling the conductors, which results in an increase in rating. Only the indirect method had been commercially adopted by the early 1980s. Another technique uses conductors placed in a pipe supported with epoxy insulators, with sulfur hexaflouride gas sealed inside. This cable has a very small capacitance, but there are problems applying it to long distances. A third technique uses the "super-conducting" phenomenon. The conductor is cooled to a very low temperature, reducing the resistance in the conductor to almost zero with dc transmission and permitting a cable with a very high transmission capacity. As mentioned above, dc transmission is being actively investigated as a technique for transmitting large blocks of power via cables.

Distribution

VOLTAGE CONSIDERATIONS

In early systems only one step of voltage transformation occurred at each end of a transmission line. As systems grew, two or more steps of voltage reduction were required at the receiving end. The high voltage needed for long-distance transmission was too high for use on city streets; yet the secondary voltage was too low for supplying electricity to consumers over a wide area. Intermediate voltages were thus introduced into the system via distribution circuits. In many systems one intermediate level is insufficient, and two or more levels are used.

Intern ate vol

As systems were interconnected, the transmission circuits of the original system often became the distribution circuits of the combined system, so that the distinction between distribution and transmission became vague. Transmission, however, in general implies larger blocks of power delivered at higher voltage to a few main substations, while distribution implies smaller blocks of power delivered at lower voltages to many smaller substations or directly to consumers.

Voltage levels. Three voltage levels are normally involved in the distribution system: (1) subtransmission voltage used in connecting the supply point on the transmission network to the distribution substations; (2) primary distribution voltage used on feeder lines from the distribution substations to the line transformers; and (3) utilization voltage, or secondary distribution voltage, for lines from the neighbourhood transformer to the customer. Subtransmission circuit voltage varies roughly from 20 to 70 kilovolts, that of primary distribution circuits from three to 20 kilovolts, and that of secondary distribution circuits from 100 to 500 volts.

The voltage for residential services in the United States is uniformly 120 volts, and in Europe it is mostly 200 or 220 volts, a difference that leads to considerable variation in distribution methods.

In the United States the voltage is reduced in a distribution substation to 2,400 to 13,800 volts. Then a second reduction is made to utilization voltage (120 volts) by means of many small transformers mounted on poles or situated in vaults called distribution transformers. In Europe the subtransmission of primary distribution voltage is brought into a kiosk, of yard, and reduced to 220 volts, and a relatively large area is covered at 220 volts. Distribution transformer output in the United States ranges from five to 100 kilovolt-amperes, whereas in Europe it is generally from 50 to 600 kilovolt-amperes.

The steady increase in load per customer requires constantly higher capacity circuits. To increase capacity, the voltage is usually increased from the initial level to a higher one as the system grows. In the United States primary distribution circuits of 2,300 or 4,600 volts were considered adequate in the early 1950s, but 12,000, 33,000, and even 69,000 volts were standard in many areas by the 1970s. Commercial and industrial loads are often supplied at the higher voltages, and high-rise buildings usually are supplied through high-voltage circuits of 480 to 12,000 volts; but the single-family residential service has not changed from 120/240 voltages, which are supplied usually from

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The Albatross
Charles Baudelaire
transmuted by Retorico Unentesi

In many the ship will slip on the love of the cracked.
Just not pre[illegible]d on the stage,
In other wo[illegible]rd and embarrassing thinking,
Pitifully, le[illegible] wings for fu[illegible] stew or
bake the Albatross, a huge seabird,
Wheat, [illegible]ding to them and [illegible]ent the handclaps! ,
The Poet is like the ri[illegible] of clouds.
It is the slights of the storm, we and so on all hanging next to them.
Travelers of this wing, as shown on the left and spine!
And it was so beautiful, it was fun and nasty!
Short pipe and irritating beak,
Another imitation,
The explosion on the g[illegible] in the middle of the blooming,
It will prevent him from waking his huge wings.

L'Albatros
by Charles Baudelaire

Souvent, pour s'amuser, les hommes d'équipage
Prennent des albatros, vastes oiseaux des mers,
Qui suivent, indolents compagnons de voyage,
Le navire glissant sur les gouffres amers.

A peine les ont-ils déposés sur les planches,
Que ces rois de l'azur, maladroits et honteux,
Laissent piteusement leurs grandes ailes blanches
Comme des avirons traîner à côté d'eux.

Ce voyageur ailé, comme il est gauche et veule!
Lui, naguère si beau, qu'il est comique et laid!
L'un agace son bec avec un brûle-gueule,
L'autre mime, en boitant, l'infirme qui volait!

Le Poète est semblable au prince des nuées
Qui hante la tempête et se rit de l'archer;
Exilé sur le sol au milieu des huées,
Ses ailes de géant l'empêchent de marcher.

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JAN

The Albatross
Charles Baudelaire
transmuted by Retorico Unentesi

In many the ship will slip on the love of the cracked.
Just not presented on the stage,
In other words, blue awkward and embarrassing thinking,
Pitifully, letters at big white wings for fun, stew or
bake the Albatross, a huge seabird,
Wheat, according to them and flying clairaudient the handclaps!
The Poet is like the rinse of clouds.
It is the slights of the storm eye and so on all hanging next to them.
Travelers of this wing, as shown on the left and spine!
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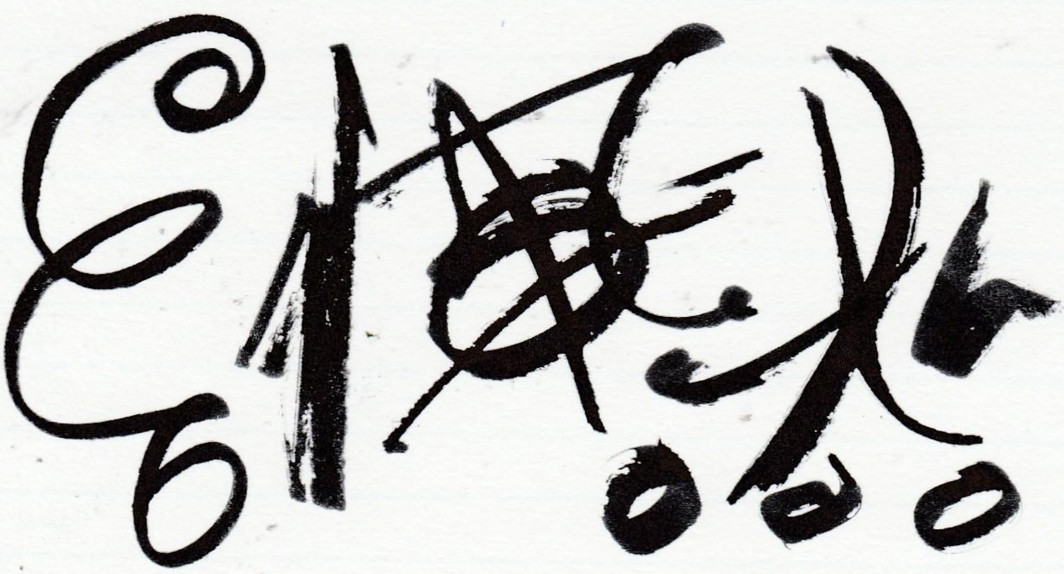

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